ARITHMETICAL ESSENTIALS

BOOK TWO

DRUSHEL-NOONAN-WITHERS

LYONS AND CARNAHAN

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PREFACE

This series of texts covers the arithmetic work of the modern curriculum from the second through the eighth grade. Three important aims are kept in mind in the selection and organization of the material used:

(1) to establish satisfactory habits of dealing with all ordinary numerical processes, involving integers, mixed numbers, common and decimal fractions;
(2) to secure the ability to organize and apply these habits in finding and expressing quantitative relations, in what is usually called problem solving;
(3) to give pupils a working knowledge of common business forms and a social insight into familiar business and industrial practices.

The problems of Book One deal with those children's interests which have arithmetical significance for them; those of Book Two deal with the interests of grown people which may be brought within the experience of children in the intermediate grades; those of Book Three deal largely with facts and experiences of grown people and are intended to give pupils an insight into business and industrial practices.

Throughout the books practice in computing has frequently been separated from problem solving in order to secure speed and accuracy. Immediate provision has, however, been made for the application of the habits formed in this way to the solution of problems from real life situations.

Pupils are frequently challenged to measure their own achievement against that of their classmates or against the records of others in their grade. They are also urged to watch their own progress in process work. To secure these results time limits are put on many exercises, the standards of achievement for com-

parable groups are stated, and pupils are urged to do better in future trials.

The books throughout have been written directly to children. All pedagogical explanations or justifications of procedures intended for the teacher are omitted from the text. The intention has been to make all explanations so clear that a normal child can understand the proper procedure without the help of a teacher.

The authors wish to express their indebtedness to the many teachers, principals, school superintendents, and business men who have aided in the preparation of these texts by their criticisms and suggestions.

SUGGESTIONS TO TEACHERS

Provision for Pupils of Varying Ability

This book is intended to provide the largest possible opportunity for self instruction for children of the 5th and 6th grades. Sufficient material is provided for the superior children of the class. The teacher should be the judge of how much the slower children of the class can accomplish.

The Project in Arithmetic

Chapter I is an example of a project worked out in considerable detail. It may serve as a hint or help in presenting local projects.

This chapter gives the children in an interesting way a review of the processes learned in Book One.

Written and Oral Work

Throughout the book pupils are encouraged to perform processes without pencil. In written work short forms should be encouraged. For this reason cancellation is introduced as a phase of division in chapter II.

Exercises for Securing Speed and Accuracy

The need of checking computations is emphasized throughout the book. In accordance with this point of view all answers to practice examples are omitted. This puts the pupil on the same basis as the business person who must strive for 100% accuracy in computations.

Chapters II, V, and IX of Part 1 and chapters III, V, and VII of Part II contain an abundance of carefully selected material for securing speed and accuracy in the fundamental processes, involving integers, mixed numbers, common and decimal fractions.

This material is intended for both practice and test purposes. The time allotted for an exercise varies from one minute to thirty minutes. The teacher is thus enabled to use these exercises under

a great variety of conditions. The short ones can be used to good advantage at the beginning of a regular recitation.

All 8 min., 4 min., and 6 min. tests in the fundamental processes with integers are standardized against the corresponding Courtis Research Tests, Series B. This enables the teacher to use the Courtis Standards in these tests.

The standards stated in all other exercises have been derived from enough cases to insure their validity.

Common Fractions

This work is limited to fractions which have practical value, such as halves, thirds, 4ths, 6ths, 8ths, 12ths, 16ths, and 24ths. On this account most of the work can be done without a pencil, thus permitting the learner to center his attention on the process rather than on some highly artificial form.

Fraction processes, because of their infrequent occurence in life, should be rationalized in order to be remembered.

The meaning of the fractional unit as a common measure of two or more fractions should be taught thoroughly, see pages 49-53. An understanding of it makes it possible to omit all the difficult, and nearly always mechanical, work of finding the least common multiple and least common denominator.

The changing of mixed numbers to improper fractions is postponed until multiplication of a mixed number by a mixed number or a fraction is reached. It is at this point that the child for the first time has practical use for this process.

Experience shows that the method of reduction in division of fractions in oral work is more rapid and more accurate than inverting the divisor. Tests show that the method of inverting the divisor is soon forgotten because hardly ever understood by pupils.

Decimal Fractions

The form of decimal fractions is taught by extending the number system to the right of the decimal point. Their meaning

is taught through the use of place value in our number system, the U. S. money table, and railroad time tables. This procedure has been found more satisfactory than to rely solely on transposing the more or less unfamiliar forms, $\frac{1}{10}$, $\frac{1}{100}$, and $\frac{1}{1000}$ into the decimal form.

The work in decimals is limited to fractions of three places on the ground that measurement to thousandths is accurate enough for practical purposes. If the learner masters the theory of decimals to three places, he should be able to make the extension to any desired number of places when the need appears.

The method used in division is the one in which the divisor is made an integer because this one has been found in experimental tests with children and adults to be more accurate.

Organization

Organization of material is not only an essential element in the learning process, but it also is a necessary factor in one's ability to use what has been learned.

The material of this book is organized for the supervisor, the teacher, and the learner. The chapter titles indicate to the supervisor the order of development that is intended for the course. The chapter analysis as shown in the table of contents should guide the teacher in the presentation of the different topics. The development of the topic in the text is for the learner.

Current Problems

All prices used in this book are those of 1918 to 1920 unless otherwise specified. In certain problems the year is stated to give historic value to the material for the purpose of comparing price fluctuations.

In problems involving the price of staple articles it is suggested that pupils find the prices current in their community and use them if they vary greatly from those given in the problems. This plan will give a sense of realness to arithmetic which the exclusive use of book problems does not give.

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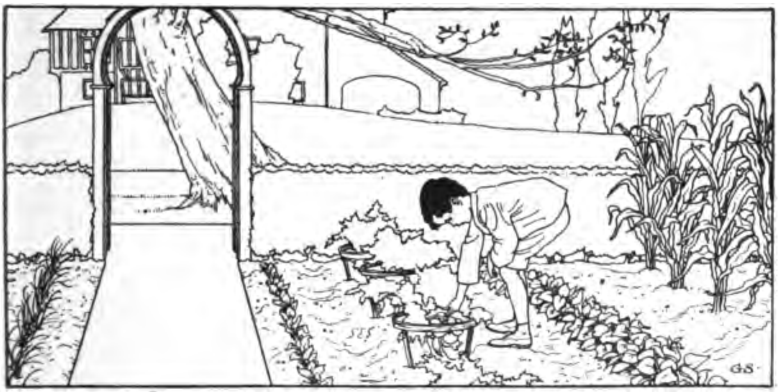
ARITHMETICAL ESSENTIALS

BOOK TWO

PART I—FIFTH YEAR

CHAPTER I

THRIFT GARDEN PROBLEMS



AT WORK IN THE GARDEN

1. A 5th grade boy in 1918 had a back yard garden. It was divided into two equal parts by a cement walk 3 feet wide, running lengthwise. Each part was 40 feet long and 10 feet wide. Find the area of the garden, of the walk, of the two together.

2. He spent for fertilizer $1.00, seeds and plants $2.65, Paris green (poison for potato bugs and cabbage worms) 25¢. His father gave him the use of the garden tools. What was the total amount spent?

3. He worked in the garden as follows:

Spading, raking, planting	15 hours
Cultivating and sprinkling in dry weather	10 hours
Harvesting and preparing his product for market	15 hours

What was the total value of his labor at 10¢ an hour? Was his time worth more than this?

4. He said that it required 5 hours to spade the garden. How many square feet did he spade an hour?

5. He did the first planting on March 15 and the last on September 2. How many days between the first and last planting? What could he plant as early as March 15, about as far north as Cincinnati, Ohio?

6. He planted turnips March 15 and sold the last May 31. How many days from planting until this ground was ready for something else?

7. He planted lettuce in a bed 5 ft. by 3 ft. March 15 and cut it the first time May 5. How many days between these dates?

8. He sold 390 radishes: 78 in April, 156 in May, 156 in June. He put 6 in a bunch, receiving a nickel a bunch in April, and a nickel for 2 bunches in May and June. How much did he get for his radish crop?

9. He divided the lettuce into portions for 3 people. He had 116 portions, $\frac{1}{4}$ of this number in May and $\frac{3}{4}$ in June. He sold the May portions at a nickel each and the June portions at 3 for 10¢. Find the value of the lettuce crop.

10. He had 3 lettuce beds, each 3 feet by 5 feet. How much did the lettuce crop bring per square foot of

area planted? Give the result to the nearest cent. Is lettuce a profitable crop?

11. The bean crop (60 hills) produced 4 lb. worth 18¢ a lb. in June; 17 lb. worth 12¢ a lb. in July; 5 lb. worth 12¢ a lb. in August; and $11\frac{1}{2}$ lb. worth 12¢ a lb. in September. Find the total value and the average value per hill.

12. The turnip patch furnished 10 portions of greens for 3 people at 5¢ a portion in April and 20 bunches of turnips at 5¢ a bunch in May. What was the value of the turnip crop?

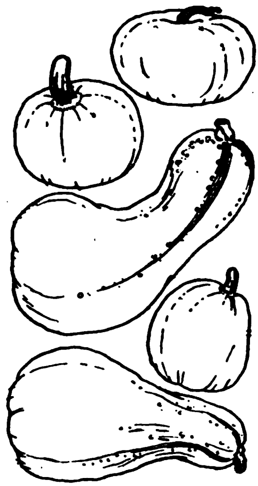
13. The 20 cabbage plants and the 30 hills of potatoes required 25¢ worth of Paris green to keep them free from worms and bugs. The cabbage crop amounted to $8\frac{1}{2}$ lb. worth 6¢ a lb., and the potatoes were too small to dig. Would you, if you were in this boy's place, plant cabbage and potatoes next year?

14. The sweet corn was planted April 20 and was gathered July 21, 12 ears worth 5¢ each. How many days did it require to grow, and how much was it worth?

15. The onion patch yielded 132 table onions which were sold in May at 5¢ for two bunches, each bunch containing 6 onions. The patch also yielded 2 quarts of onion sets, dug in September, worth 15¢ a quart. Find the value of the onion crop.

16. From his 30 tomato plants he sold the following: in July, 30 tomatoes at 3¢ each; in August, $112\frac{1}{4}$ lb. at 6¢ a lb.; in September, 29 lb. at 5¢ per lb. Find the value of his tomato crop.

17. His 15 squash plants grew the following:



2 Summer cushaws, each weighing $21\frac{1}{2}$ lb., worth 5¢ per lb.
12 Yankee pie squashes, total weight 60 lb., worth 5¢ per lb.
7 Mammoth pie squashes, total weight 58 lb., worth 4¢ per lb.

Find the value of the squash crop. If you were in this boy's place, would you plant squash seeds next year?

18. He estimated the parsley crop for the season at 50 bunches worth 5¢ each, grown in a bed 5 feet by 3 feet. Was this a profitable crop? What was the value per square foot of area planted? Give the answer to the nearest cent.

19. He divided his Swiss chard into portions. He said that a portion was enough for two messes for a family of three. He sold it at 10¢ a portion as follows: June, 12 portions; August, 5 portions; September, 7 portions; October, 15 portions. Find the value of this crop.

20. He sold beets at a penny each as follows: in June, 25, in July, 51; in October, 25. In August he sold $15\frac{1}{4}$ lb.; in September, $4\frac{1}{2}$

lb., receiving 6¢ a lb. in each month. Find the value of his beet crop. Why do you think he preferred to sell by weight for the two months?

21. The carrots were put into bunches: 5 of medium size, or 2 large and 3 small ones, or 8 small ones to a bunch. They were sold by the bunch as follows: June, 9 bunches at 6¢ each; July, 7 at 6¢ each; August, 10 at 5¢ each; September, 14 at 2 for 5¢; October, 8 at 2 for 5¢; November, 8 at 5¢ each; December, 10 at 5¢ each; January, 1919, 8 at 6¢ each. Find the value of the carrot crop.

22. He sold during the season 29 lb. of parsnips at 5¢ per lb. On March 1, 1919, he estimated that he still had 15 lb. in the ground to be sold during the month at 6¢ per lb. How much was his parsnip crop worth?

23. In the last three months of 1918 he sold 10 large heads of endive at 10¢ each, 40 medium size heads at 5¢ each, and 32 small heads at 2 for 5¢. Find the value of the crop.

24. The total income from the garden during the season was $49.20. What was left after taking away the cash expense, $3.90, and the labor cost, $4.00?

25. The boy said what he learned from the garden paid him for his work. If this is true, what did he make?

26. State some valuable information which the boy should have gained from his 1918 garden.

27. The total income during the season of 1919 from this same garden was $52.15. How much more was that than the year before?

During the season the boy learned how to keep an account with his garden. He did it this way. All money he spent on the garden, he charged to it. (Put on the debit side.) Everything of value grown in the garden was credited to it. (Put on the credit side.) The first part of the account is shown below.

Garden Account

Debit	*(Am't pd. to Garden)*		*(Am't rec'd from Garden)*		*Credit*
Mar. 1	*To Fertilizer*	*$1.00*	*Apr. 30*	*By Radishes*	*$ .65*
10	*Seeds*	*1.20*	*30*	*Turnip Greens*	*.50*
15	*Onion Sets*	*.30*	*30*	*Balance*	*1.35*
		$2.50			*$2.50*
May 1	*To Balance*	*$1.35*			

On April 30 the boy found the balance, $1.35, by subtracting the total received from the Garden during April, $1.15, from the total, $2.50, paid out for the Garden during March. This balance is written on the credit side as shown in the account. It is the amount which must be added to the smaller side of an account (in this case the credit side) to make it equal to the larger side.

On May 1 the balance is written on the debit side because this is the amount the garden is in debt at that time. This is called opening the account.

Make the account for May. Supply the dates as you think proper. See problem 2 for $1.15 worth of plants bought and a 25¢ charge for Paris green. See problems 8, 9, 12, and 15 for radishes, lettuce, turnips, and onions sold.

Find the balance on May 31. At this time the credit side is larger than the debit side. How much larger? What does such a condition mean?

Business men keep an account with Cash in the same way the boy kept his Garden Account. They charge Cash with all money received and credit Cash with all money paid out.

Many boys and girls keep an account with their cash. Why is this a good thing?

This is part of a 5th grade boy's Cash Account.*

Cash

Dr. (*Am't pd. Cash*) (*Am't rec'd from Cash*) *Cr.*

May 1	*To Bal. on Hand*	*$2.25*	*May 2*	*By Expenses (Movies).*	*$ .15*
3	*Errands......*	*.25*	*5*	*Books (Sketch Bk.)*	*.50*
7	*Earnings.....*	*1.00*	*6*	*Thrift Stamps (3)..*	*.75*
8	*Berries.......*	*.50*			

1. Balance this account on May 8.

2. What does the balance show?

3. Reopen the account on May 9th. For the method see the Garden Account.

4. Complete the account for May using the following items: May 12, spent for candy 25¢; May 15, earned by working as delivery boy 60¢; paid for thrift stamps 50¢; May 20, spent at the movies 11¢; May 22, earned at the grocery store 50¢; May 26, paid for two books $1.00; received for running errands 20¢; May 29, received for cutting grass 25¢. Find the balance May 31.

* It is a good plan for boys and girls to keep an expense book. If you want more practice in making accounts, continue the Garden Account on page 6 through June, July, and August. Get the facts you need from the problems on pages 3, 4, and 5.

CHAPTER II

THE FUNDAMENTAL PROCESSES

Rapid Work in Addition and Subtraction

Write on a slip of paper laid below the examples all the sums in $1\frac{1}{2}$ min. Write on another slip all the differences in $1\frac{1}{2}$ min.

1	2	3	2	3	3	4	4	4	5	4	5	5	6	5
1	1	1	2	3	2	1	2	3	1	4	2	3	1	4

5	7	6	6	7	7	6	6	8	7	7	9	7	8	8
5	1	2	6	2	3	4	5	1	5	6	1	7	2	8

9	6	8	8	9	9	9	9	8	9	9	8	8	9	7
9	3	3	7	8	2	3	7	6	4	6	5	4	5	4

In the above test you wrote 45 addition facts, and the 45 subtraction facts whose minuends are less than 10. In the next test are found the 45 subtraction facts whose minuends are greater than 9. A good 5th grade pupil should write correct answers for all of them in two min. If your mark is below 100, practice 2 min. each day until you can make a perfect score.

18	10	16	12	17	15	12	15	13	14	16	10	11	10	10
9	9	9	9	8	8	7	6	5	8	7	7	6	4	1

17	14	12	13	14	10	12	11	12	11	16	11	14	10	13
9	9	8	7	6	6	5	4	3	9	8	7	5	2	4

13	10	14	13	10	10	15	12	11	11	12	11	15	13	11
9	8	7	6	5	3	7	6	3	2	4	8	9	8	5

Write as rapidly as you can the sum in each of these examples. Add the columns, then the lines.

	a	b	c	d	e
1.	2	7	3	2	
2.	6	2	1	4	
3.	8	4	8	5	

	f	g	h	i	j
4.	6	9	3	7	
5.	2	7	9	6	
6.	8	4	9	7	

7.	2	3	9	6	
8.	7	5	6	6	
9.	8	4	4	9	

10.	3	2	7	8	
11.	8	5	6	8	
12.	9	8	5	4	

In column addition it often saves time to add by easy groups of addends by using the combinations already learned. Thus, in the first example below, beginning at the bottom a pupil who was good at adding, said 10, 19, 22, 32, instead of 8, 10, 15, 19, 22, 30, 32. Another rapid adder said 10, 22, 32. How would you add it?

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
2	3	6	2	1	3	6	2	5	2	6	2	9	1
8	2	2	4	9	6	2	8	5	1	3	8	6	9
3	8	4	3	4	5	3	3	2	2	6	4	5	5
4	2	6	7	6	5	4	7	3	8	4	6	4	5
5	7	3	2	2	5	5	2	6	7	3	1	7	3
2	3	2	6	7	3	4	3	8	3	9	7	6	9
5	8	9	8	6	7	9	4	4	4	2	3	4	4
3	9	7	8	9	8	2	8	7	3	8	9	4	8

Beginning with 17, count by 4's to 49.

Rapid Addition and Subtraction

In this exercise there are 5 examples in each column and 8 in each line. Write the sums of the examples in the columns.

Write on another slip of paper the sums of those in lines. Compare the two sets of answers.

Write the differences in the same way.

	a	b	c	d	e	f	g	h
1.	32 8	72 9	45 6	69 7	39 5	29 8	44 7	52 9
2.	55 5	75 6	49 7	21 8	28 9	37 3	46 4	22 5
3.	99 4	89 3	79 2	69 9	59 8	49 5	39 6	29 7
4.	38 8	19 9	17 6	27 4	36 3	42 8	52 6	68 4
5.	96 9	86 7	94 8	93 6	39 4	49 5	51 9	18 3

Write the correct answers for these examples in 3 min.

56	22	96	82	56	14	41	39
27	78	82	85	93	40	41	39
28	38	30	15	64	28	51	12
15	45	79	36	83	55	38	59
45	11	63	80	78	46	44	76

Counting To or From

1. Beginning with 1, count by 8's to 97.
2. Beginning with 19, count by 9's to 100.
3. Beginning with 16, count by 7's to 100.
4. Beginning with 4, count by 6's to 100.
5. Beginning with 100, subtract by 8's to 4.
6. Beginning with 100, subtract by 6's to 4.
7. Beginning with 100, subtract by 9's to 1.
8. Beginning with 0, count by 12's to 96.
9. Beginning with 0, count by 25's to 200.
10. Beginning with 0, count by 20's to 200.

Adding Two Numbers without Pencil

Add to the first number the largest decade of the second. Then to this sum add units of the second.

$34+68=?$ HINT.—Think "I must add to 34, 60 and 8." Say or write 102.

	1.	2.	3.
(*a*)	$25+75=?$	$37+23=?$	$27+28=?$
(*b*)	$34+62=?$	$76+26=?$	$63+49=?$
(*c*)	$58+25=?$	$95+15=?$	$37+29=?$
(*d*)	$63+37=?$	$53+37=?$	$22+38=?$
(*e*)	$84+16=?$	$62+29=?$	$16+54=?$
(*f*)	$29+19=?$	$51+49=?$	$52+25=?$

In each of the above groups of 2 numbers, what must you add to the smaller to make the larger?

HINT.—In the first example in line *b*, think "I must add 20 and 8." Say 28.

Making Change

1. Name the coins from 1¢ to one dollar.

2. Name the paper money bills from $1 to $20.

3. To make change, add to the amount of the sale, or to the payment to be made, enough to equal the amount offered in payment.

EXAMPLE.—A boy buys $1.42 worth of groceries and offers a $2.00 bill in payment. What is the change?

Amt. of Sale + Change = Money Changed
$1.42 + (3¢+5¢+50¢) = $2.00

The merchant or clerk hands the customer his package and the change consisting of 3 pennies, a nickel, and a half dollar. He says, "One dollar forty-two, forty-three, forty-four, forty-five, fifty, two dollars." The person making the change tries to use the smallest number of pieces possible. Why? The customer should count his change as it is given him. Why?

Make change in each of these examples. Use as few pieces as possible.

	Amt. of Sale	Money Changed	Amt. of Change	No. of Pieces
1.	$1.75	$5.00	25¢+$1+$2	3
2.	.33	1.00	?	?
3.	3.57	5.00	?	?
4.	.15	.50	?	?
5.	.23	5.00	?	?
6.	2.52	3.00	?	?

Each of the numbers in this exercise is a purchase. State the amount of change the customer should receive if one dollar is offered in each case.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
(*a*)	24¢	19¢	37¢	41¢	52¢	25¢	63¢	43¢	82¢	94¢
(*b*)	54¢	65¢	85¢	13¢	73¢	55¢	81¢	90¢	23¢	17¢
(*c*)	66¢	69¢	96¢	76¢	67¢	88¢	8¢	18¢	72¢	35¢
(*d*)	74¢	47¢	85¢	78¢	22¢	44¢	49¢	59¢	71¢	38¢
(*e*)	11¢	21¢	14¢	20¢	91¢	32¢	79¢	51¢	15¢	34¢

Problems about Making Change

1. When Susan's mother paid her milk bill of $3.16, she offered a $10 bill in payment. How much change should she have received?

2. Roy sent three packages by parcel post. On one he needed 16¢ in postage; on another, 23¢; and on the third one, 25¢. How much change did he get out of $1.

3. Lucy bought these postage stamps: two 10 cent stamps, three fives, 8 twos, and 12 ones. How much change should she have out of a $5 bill?

4. Tom bought these groceries: coffee, 35¢; sugar, 25¢; canned goods, 48¢; oranges, 30¢. The grocer handed him 52¢ change out of a $2 bill. Was this right?

5. A workman had $2.50 left in his weekly pay envelope after paying these bills: $3.62, $14.40, $5.60. How much was in the pay envelope at first?

6. John's grandmother's town is exactly 64 mi. from his own by railroad. When the fare was 3¢ a mile, how much change did he get out of $2 if he bought a one way ticket?

Adding Large Numbers

In column addition some pupils make use of the combinations already learned in this way.

3462	Adding the 1st column, think 17 and 8, say 25.
2596	Adding the 2nd column, think 15 and 15, say 30.
3478	Adding the 3rd column, think 12 and 9, say 21.
2569	Adding the 4th column, think 7 and 5, say 12.
12105	

Place a sheet of paper below the example and write as many correct answers as you can in 10 minutes. A good 5th grade pupil should have 12 right. Prove your answers by adding in the opposite direction.

1.	2.	3.	4.	5.
9648	6385	7638	4891	4938
8137	9369	5466	1948	8963
4869	6138	2397	3763	2456
6411	4252	9423	2439	3585

6.	7.	8.	9.	10.
3681	6481	7547	8147	4869
2479	7638	8643	7418	2831
6349	8399	2259	6291	3699
4859	1933	7378	3849	7854

11.	12.	13.	14.	15.
3679	5402	6474	5386	3839
9381	6393	4746	6835	6259
5267	8940	3962	8474	8439
3846	5476	7149	3637	9239

The following examples contain all the 45 subtraction facts whose minuends are greater than 9. See how long it takes you to write the answers on a slip of paper* laid below the examples. Then prove your answer to each example by adding it to the subtrahend. If correct, the sum must be equal to the minuend.

	a	b	c	d	e
1.	5263 1825	6352 4717	1546 1029	6904 3258	5362 4289
2.	2781 1279	5248 2967	1905 1377	5426 2879	3007 2148
3.	9000 2462	3642 2984	6317 2979	6014 5295	3051 2674
4.	3058 2659	2863 1678	6072 5994	4321 1895	2611 1652
5.	3982 2946	5343 3435	1684 1597	7501 2883	5000 3604
6.	8742 3695	8004 2995	3129 1638	63780 45999	7104 6908
7.	3625 1876	4004 1568	9521 3783	6107 2438	5362 1296

* NOTE.—Make two narrow strips of paper, each folded lengthwise through the middle. By doing this you will save much time.

Test Problems

The wide-awake man or woman, boy or girl, does not look around for paper and pencil every time he or she wishes to solve a problem.

1. There are 34 children in one schoolroom and 38 in another. How many in both? If the two rooms have the same grade of work, how could the principal divide the pupils so that he would have the same number in each room?

2. Mary bought 2 yd. of ribbon. After using 50 inches, how much had she left?

3. Gilbert earned 48¢ on Monday and 75¢ on Tuesday. How much more did he earn on Tuesday than on Monday? How much less on Monday than on Tuesday?

4. A boy raised 120 lb. of tomatoes in his thrift garden. During the summer, he ate 15, whose weight was 10 lb., and gave his mother 10 lb. The rest he sold, getting on an average 4¢ a lb. How much money did he get? What was his entire crop worth at 4¢ a lb?

5. Room 12 in the Wyman School had a problem-solving contest. The girls solved 42 right, which was 9 more than the boys had right. How many did the boys have right? How many did the room have right?

6. If in problem 5 the girls missed 8 and the boys missed 7, how many did both try? How many more did the girls try than the boys?

7. Mary brought 36 post cards to her class in geography. Her classmates afterwards gave her 25. How many did she then have?

8. When apples were 3 for a dime, how many could be bought for 30¢?

9. How many pencils can you buy for 25¢ at the rate of 2 for a nickel?

10. If you buy 2 tablets at 6¢ each, a reader for 42¢, and an arithmetic for 60¢, how much change will you get out of a two dollar bill?

Problems

Use pencil.

1. A man bought three horses, paying for the first, $125; for the second, $140; and for the third, $150. He sold them all for $480. Did he gain or lose? How much?

2. Bertha tried to solve 15 problems on Monday, 17 on Tuesday, 19 on Wednesday, 14 on Thursday, 16 on Friday. She missed 7. How many did she have right?

3. There are 40 pupils in Room 1, 46 in Room 2, 45 in Room 3, 47 in Room 4. How many in all the rooms?

4. Name these lakes. What is their total area in square miles? What is the difference between the largest and the smallest?

5. The area of Ohio in square miles is 40060; of Indiana, 36350; of Illinois, 56650; of Michigan, 58915; of Wisconsin, 56040. Find their combined area. What is the difference between the largest and the smallest? What is the difference between the two most nearly equal?

Multiplication

1. $\$8+\$8+\$8+\$8+\$8=5\times\$8=\$40$.

In problem solving it is more convenient to say 5 times $\$8=\$40$ than to add five 8's.

Multiplication is a short process of adding equal numbers. It is taking one number as many times as there are units (ones) in another.

2. John bought 6 oranges at 5¢ each. What did they cost?

In this problem 6 is the **multiplier,** 5¢ is the **multiplicand,** and 30¢ is the **product.** The product and multiplicand have the same name. The multiplier is without a name. It shows how often the multiplicand is taken.

3. The sign $\times$ is read **times** when the multiplier precedes it and **multiplied by** when the multiplier follows it. $6\times$(times)$\$2=\$12$. $\$2\times$(multiplied by)$6=\$12$. Does \$2 times 6 mean anything?

4. In the following read first the multiplier, then the entire expression.

(1) 8 ft.$\times 3=24$ ft.	(4) 6×7 in.$=42$ in.
(2) $7\times\$8=\$56$	(5) 2 yd.$\times 4=8$ yd.
(3) $3\times 6=18$	(6) $6\times 4=24$

5. Show by addition that $6\times\$3=3\times\$6$.

6. The multiplier and multiplicand are often called **factors** of the product.

3 and 4 are factors of 12 because $3\times 4=12$.

7. Name two factors of each of these products: \$24, 36 ft., 15 in., 16 yd., 32, 48 mi., 56 da., 24 hr.

Principles of Multiplication

I. The multiplier is always an abstract number (without a name). Why?

II. The product and the multiplicand have the same name. Why?

III. The order in which the factors stand does not affect the product. Show the truth of this statement.

Tests

I

This test contains all the difficult multiplication facts. A 5th grade pupil should be able to write the correct answers for all of them in two min. If you miss any of them try again tomorrow.

3	4	9	0	5	4	3	2	7	4	9	6	5	4	7
2	7	8	2	6	1	6	9	6	0	5	9	2	8	0
6	2	9	0	7	9	2	7	0	8	9	3	9	2	4
5	7	6	5	4	7	8	7	6	3	2	8	9	0	3
4	8	0	4	6	6	0	9	3	6	3	6	7	5	4
4	9	3	5	2	8	7	3	4	8	9	3	9	5	6

II

In the table below write the products obtained by multiplying all the numbers in the upper line by each number in the lower line. If you can do this, you know the multiplication facts to 12 times 12.

6	4	5	3	2	0	1	7	12	10	8	11	9
8	5	4	2	12	11	3	1	6	7	9	10	0

III

The following exercise requires the use of all the multiplication facts to 9×9. Write the correct answers in three minutes.

25304	30875	17689	68179	31542	71689
×5	×2	×5	×9	×6	×3
86179	43025	78906	61296	32047	42035
×7	×8	×4	×2	×10	×9
87069	20543	53024	61789	69158	35124
×6	×3	×7	×8	×10	×4

IV

1. How do you multiply a number by 10? by 100? by 1000?

2. Multiply 14 by 20, by 200, by 2000.

3. Multiply 15 by 30, by 40, by 70, by 80.

Write the products only.

	a	b	c	d	e
4.	208	85	74	128	64
	×5	×6	×200	×30	×2000
5.	307	96	34	256	58
	×4	×5	×900	×40	×5000
6.	908	54	72	142	48
	×8	×9	×700	×60	×9000

	2's	3's	4's	5's	6's	7's	8's	9's	10's	11's	12's	
1	2	3	4	5	6	7	8	9	10	11	12	1's
2	4	6	8	10	12	14	16	18	20	22	24	2's
3	6	9	12	15	18	21	24	27	30	33	36	3's
4	8	12	16	20	24	28	32	36	40	44	48	4's
5	10	15	20	25	30	35	40	45	50	55	60	5's
6	12	18	24	30	36	42	48	54	60	66	72	6's
7	14	21	28	35	42	49	56	63	70	77	84	7's
8	16	24	32	40	48	56	64	72	80	88	96	8's
9	18	27	36	45	54	63	72	81	90	99	108	9's
10	20	30	40	50	60	70	80	90	100	110	120	10's
11	22	33	44	55	66	77	88	99	110	121	132	11's
12	24	36	48	60	72	84	96	108	120	132	144	12's
	2	3	4	5	6	7	8	9	10	11	12	

NOTE.—The numbers outside of the outer heavy lines are factors. The numbers within the outer heavy lines are either products or dividends.

For multiplication, find one factor in the first left hand column and the other either in the top or the bottom line.

EXAMPLE.—10 9's $=90$; or, $10 \times 9 = 90$. Where does the product stand?

For division, find the divisor and dividend in the same line or in the same column.

EXAMPLES.—$\frac{1}{9}$ of $27 = 3$. 9's in 27 are 3. Where is the quotient found?

1. Find any other good way to use this table in reviewing the multiplication and division facts.

2. In the third grade you learned the tables through the 10's shown by the small oblong set off from the large oblong by the light lines. See how easy it is to learn the rest of the big oblong as given above.

3. Study the above table. Then without the book make one just like it on heavy paper.

4. Only when in doubt, rather than guess, refer to the table you made.

	348	Multiplicand.
	26	Multiplier.
$6 \times 348 =$	2088	First partial product.
$20 \times 348 =$	696	Second partial product. **Read 6960.**
$26 \times 348 =$	9048	Complete product.

In long multiplication place the first right hand figure of the partial product in the same column as the figure of the multiplier used.

Examples

1. 264×36	**6.** 748×29	**11.** 521×19
2. 384×72	**7.** 385×74	**12.** 693×18
3. 965×27	**8.** 629×25	**13.** 842×37
4. 217×96	**9.** 332×99	**14.** 979×49
5. 869×42	**10.** 482×78	**15.** 819×59

Saving Time in Multiplication

The shortest way in multiplication is usually the most accurate.

I. When one factor is 20, 200, or 2000, double the other factor and annex one, two, or three zeros.

$34 \times 20 = 680. \qquad 20 \times 49 = 980.$

Write the products for these examples.

1. 200×68	**3.** 2000×4	**5.** 16×20	**7.** 162×200
2. 200×75	**4.** 2000×7	**6.** 18×20	**8.** 144×200

II. When there is a zero in one factor, make that factor the multiplier. This will reduce the number of partial products.

In 804×367, 804 should be the multiplier; but in 358×205, 205 should be the multiplier. Why? Make a careful count to see how much work you actually save by this suggestion.

Select the proper multiplier in each of these examples. Then multiply.

1. 205×864	**4.** 508×294	**7.** 324×210
2. 385×605	**5.** 694×309	**8.** 603×297
3. 426×640	**6.** 785×907	**9.** 708×874

III. When one factor is 25, annex two zeros to the other and divide by 4.

25 is $\frac{1}{4}$ of 100. Therefore, multiplying by 25 is the same as multiplying by 100 and dividing the product by 4.

EXAMPLE.—$84 \times 25 = ?$ Think two zeros after 84 and divide by 4. Write or say 2100.

Solve this example by the long method. Count the number of steps in multiplication and addition you have saved by the short method.

Multiply each of these numbers by 25. Write answers only.

16	24	72	44	96	28	32	20	8	12
92	36	80	68	76	56	128	144	288	964

Practice

Find a short way for each of these examples.

1. 634×207	**2.** 804×369	**3.** 503×721
4. 607×842	**5.** 363×240	**6.** 304×589
7. 864×25	**8.** 509×604	**9.** 25×568
10. 25×624	**11.** 832×207	**12.** 848×25
13. 25×648	**14.** 923×200	**15.** 450×502

Problems

1. A newsboy bought one thrift stamp (worth 25¢) each week for 2 years. How much money did he invest?

2. Some automobiles run on an average 15 mi. for every gallon of gasoline used. The owner of such a car used in one year 228 gallons of gasoline. Find the cost of the gasoline at $22\frac{1}{2}$¢ a gallon and the distance traveled by the machine.

3. When sound travels 1090 ft. a second, how far can it go in a minute?

4. A merchant bought 25 rolls of carpet, each containing 45 yards, at $1.25 a yard; also 20 rolls each containing 54 yards, at $1.05 a yard. How much did all the carpet cost?

5. The merchant of problem 4 sold all the carpet at an average of $1.20 a yard. Did he gain or lose? How much?

6. A farmer raised 657 bushels of wheat and 915 bushels of corn. He kept 45 bushels of the wheat for seed and sold the remainder at $2.20 (1918) a bushel. He kept 265 bushels of the corn and sold the remainder at $1.60 (1918) a bushel. How much did he receive for the wheat and corn sold? How much would he receive for all the grain if it were sold at the market price at the time you solve this problem?

7. In September, 1918, a cattleman went to market with 15 cars of fat cattle, 36 head in each car, averaging 1165 pounds a head. He received $14.00 a hundred pounds. How much did he get for all his cattle?

8. On September 4, 1918, cattle were sold in a market of a large city as follows:

No.	Av. wt.	Price per lb.	No.	Av. wt.	Price per lb.
1	1090	18¢	21	1125	15¢
22	769	$9\frac{1}{2}$¢	40	1047	$15\frac{1}{4}$¢
40	869	15¢	16	792	11¢
27	1010	13¢	5	820	$9\frac{1}{2}$¢
5	1210	$16\frac{1}{2}$¢	9	507	8¢
45	1130	16¢	17	593	$7\frac{1}{2}$¢

Find the value of each of the 12 lots. Find the total value of all.

9. How do you explain the large difference in price per lb. in the different lots of cattle in problem 8? Consult your own paper for the cattle market at the time you solve these problems. Find three cities having large cattle markets.

10. Make and solve two good problems based on the market you have read.

Division

1. If the dividend is 24¢ and the divisor 4¢, what is the quotient? What is the quotient if the divisor is 4?

2. If the dividend is 18 lb. and the divisor is 3 lb., what is the quotient? What is the quotient if the divisor is 3?

3. From the above we see that with a concrete dividend (one with a name) the divisor may be concrete or abstract (without a name). This gives two kinds of division. One is called measuring; the other is called separating.

(1) John has 25¢, which he wishes to spend for oranges at 5¢ each. How many can he buy?

In this kind of division (measuring) the dividend and divisor have the same name. The quotient is without a name. It tells how often the dividend contains the divisor.

$$5¢\overline{)25¢}\;\;5 \qquad \text{25¢ contains 5¢ five times.}$$

(2) Mr. Brown has 25 apples which he wishes to divide equally among 5 boys. How many apples will each receive?

In this kind of division (separating) the divisor is without a name. It tells into how many equal parts the dividend must be separated. The dividend and quotient have the same name. The quotient tells the size of each part.

$$5\overline{)25 \text{ apples}}\;\;5 \text{ apples} \qquad \tfrac{1}{5} \text{ of 25 apples} = 5 \text{ apples.}$$

Principles

I. When the dividend and divisor are both concrete (with a name), the quotient is abstract. It shows how many times the dividend contains the divisor. Write and solve a problem which illustrates this principle.

II. When the dividend is concrete and the divisor abstract, the quotient is concrete. It shows the size of one of the equal parts into which the dividend is divided. Show this principle with a problem.

III. When both dividend and divisor are abstract, the quotient is abstract, and it may represent either the number of equal parts or the size of each equal part.

Practice in Telling the Kinds of Division

In each of these problems first tell which kind of division is employed, then solve in the shortest way.

1. When oranges were 3 for a dime, how many were bought for 30¢?

2. How many quarts in 8 pints of milk?

3. A boy raised 12 pecks of tomatoes. How many bushels?

4. How many feet in 84 inches?

5. A young man raised 3,300 lb. of a new variety of Irish potatoes on a one-tenth acre garden plot. How many bushels is that to the acre if there are 60 lb. in a bushel?

6. If you set 6 dozen eggs worth 40¢ a dozen and 60 of them hatch, what is the cost of each chicken?

7. A girl set 24 cabbage plants in her thrift garden. She harvested 16 heads averaging 3 lb. each at 4¢ per lb. What was the average amount received per plant?

Practice Exercise

Tell the missing number for all these in one min.

1. 15 ft. ÷ 5 ft. = ?
2. 32 pt. ÷ 8 = ?
3. $40 ÷ $5 = ?
4. 24 mi. ÷ 3 mi. = ?
5. 42 ft. ÷ 6 ft. = ?
6. 18 qt. ÷ 3 qt. = ?
7. 8 yd. ÷ 4 = ?
8. 32 oz. ÷ 8 = ?
9. 16¢ ÷ 4 = ?
10. 25¢ ÷ 5¢ = ?
11. 18 lb. ÷ 6 = ?
12. 21 trees ÷ 3 trees = ?
13. 20 in. ÷ 4 = ?
14. 15 lb. ÷ 3 lb. = ?
15. 36 in. ÷ 9 in. = ?
16. 56 plums ÷ 8 = ?

Short Division Tests

I

Write as many correct answers as you can in one minute.

$4\overline{)32}$	$6\overline{)36}$	$2\overline{)0}$	$7\overline{)28}$	$9\overline{)9}$	$3\overline{)21}$	$6\overline{)48}$	$1\overline{)1}$	$7\overline{)63}$	$6\overline{)0}$
$8\overline{)32}$	$1\overline{)8}$	$5\overline{)30}$	$8\overline{)72}$	$1\overline{)0}$	$9\overline{)36}$	$1\overline{)7}$	$7\overline{)42}$	$1\overline{)1}$	$6\overline{)18}$
$3\overline{)6}$	$4\overline{)20}$	$7\overline{)49}$	$1\overline{)3}$	$6\overline{)6}$	$3\overline{)27}$	$8\overline{)64}$	$1\overline{)2}$	$4\overline{)16}$	$5\overline{)0}$
$9\overline{)81}$	$3\overline{)24}$	$9\overline{)63}$	$2\overline{)4}$	$8\overline{)24}$	$7\overline{)7}$	$2\overline{)18}$	$6\overline{)42}$	$3\overline{)0}$	$7\overline{)0}$
$3\overline{)18}$	$9\overline{)18}$	$4\overline{)36}$	$7\overline{)35}$	$7\overline{)56}$	$6\overline{)24}$	$3\overline{)24}$	$5\overline{)25}$	$3\overline{)9}$	$9\overline{)72}$

II

Write quotient and remainder only.

$7\overline{)44}$	$3\overline{)25}$	$6\overline{)37}$	$8\overline{)45}$	$5\overline{)33}$	$9\overline{)60}$	$5\overline{)29}$	$2\overline{)17}$	$8\overline{)35}$	$9\overline{)78}$
$8\overline{)58}$	$6\overline{)53}$	$7\overline{)40}$	$4\overline{)39}$	$5\overline{)50}$	$6\overline{)67}$	$9\overline{)29}$	$7\overline{)52}$	$8\overline{)27}$	$6\overline{)50}$
$6\overline{)19}$	$7\overline{)66}$	$7\overline{)73}$	$8\overline{)64}$	$6\overline{)25}$	$7\overline{)39}$	$8\overline{)41}$	$9\overline{)42}$	$7\overline{)16}$	$8\overline{)61}$
$8\overline{)15}$	$7\overline{)36}$	$3\overline{)13}$	$4\overline{)19}$	$4\overline{)49}$	$7\overline{)11}$	$8\overline{)39}$	$6\overline{)23}$	$9\overline{)17}$	$9\overline{)21}$
$9\overline{)89}$	$9\overline{)79}$	$6\overline{)59}$	$7\overline{)59}$	$8\overline{)59}$	$9\overline{)73}$	$8\overline{)74}$	$6\overline{)29}$	$5\overline{)49}$	$3\overline{)29}$
$9\overline{)39}$	$4\overline{)23}$	$4\overline{)42}$	$9\overline{)49}$	$3\overline{)13}$	$5\overline{)38}$	$3\overline{)26}$	$4\overline{)33}$	$5\overline{)19}$	$3\overline{)17}$

III

Time yourself on these examples. Prove your answers.

$6\overline{)21279}$	$7\overline{)39872}$	$3\overline{)82458}$	$9\overline{)71289}$	$5\overline{)41980}$	$8\overline{)66720}$
$4\overline{)38968}$	$6\overline{)58203}$	$9\overline{)24677}$	$8\overline{)35648}$	$7\overline{)24325}$	$6\overline{)25326}$

IV

Divide each of the following by 6, then by 7, then by 8, then by 9. Write the quotient and remainder only. Do them by lines on one slip of paper. On another do them by columns. When you have finished, compare the answers on the two slips.

Time yourself today. Try to do better tomorrow.

	a	b	c	d	e	f	g	h	i	j
1.	17	27	37	47	57	67	7	24	50	29
2.	23	33	43	53	63	36	5	30	40	39
3.	16	26	36	46	56	66	9	18	20	49
4.	11	21	31	41	51	61	8	12	71	59

V

Write the quotients only.

1. $1824 \div 4 = ?$	16. $5454 \div 6 = ?$
2. $4852 \div 2 = ?$	17. $4455 \div 9 = ?$
3. $1788 \div 3 = ?$	18. $1728 \div 8 = ?$
4. $2460 \div 6 = ?$	19. $1280 \div 4 = ?$
5. $9627 \div 3 = ?$	20. $3575 \div 5 = ?$
6. $3836 \div 7 = ?$	21. $3178 \div 7 = ?$
7. $9648 \div 8 = ?$	22. $5004 \div 9 = ?$
8. $2625 \div 5 = ?$	23. $6208 \div 8 = ?$
9. $6984 \div 9 = ?$	24. $7362 \div 9 = ?$
10. $3762 \div 9 = ?$	25. $7248 \div 6 = ?$
11. $5824 \div 7 = ?$	26. $3443 \div 11 = ?$
12. $6048 \div 8 = ?$	27. $3024 \div 12 = ?$
13. $5384 \div 4 = ?$	28. $1332 \div 12 = ?$
14. $6935 \div 5 = ?$	29. $5676 \div 11 = ?$
15. $4851 \div 3 = ?$	30. $5676 \div 12 = ?$

Long Division

```
                9586 Quotient
Divisor  45)431374 Dividend
            405
             263
             225
              387
              360
               274
               270
                 4 Remainder
```

Think, "There are 9 45's in 431 because 43 is almost 45." Place 9 over 1. Multiply 45 by 9. This product is less than 431. Subtract. The remainder is 26, which is a little more than $\frac{1}{2}$ of the divisor. Therefore try 5 for the next partial quotient after bringing down the next figure. Multiply 45 by 5, and proceed as before. Try 8 because 387 is a little less than 405 (9×45). Try 6 because 274 is more than 225 (5×45), also because there are six 4's in 27.

Proof. Divisor $\times$ Quotient $+$ Remainder $=$ Dividend.

Steps in Long Division

1. Find the trial quotient.

2. Multiply the divisor by the trial quotient.

3. Compare this product with the partial dividend under which it stands. What is the meaning if this product is larger than this partial dividend?

4. Subtract.

5. Compare the remainder with the divisor. If the remainder is as large or larger than the divisor, the last trial quotient is too small. If the remainder is a little less than $\frac{1}{2}$ of the divisor, try 4 for the next quotient. If it is exactly half or a little more than half, try 5. If the remainder is almost as large as the divisor, try 9. The remainder **often** tells the next quotient figure.

Examples

I

	a	b	c	d
1.	$29\overline{)1073}$	$28\overline{)4060}$	$27\overline{)7155}$	$72\overline{)55296}$
2.	$89\overline{)45924}$	$28\overline{)26712}$	$44\overline{)13552}$	$86\overline{)55560}$
3.	$22\overline{)34678}$	$62\overline{)4030}$	$46\overline{)2116}$	$66\overline{)4554}$
4.	$69\overline{)4071}$	$47\overline{)4653}$	$91\overline{)5551}$	$61\overline{)3111}$
5.	$76\overline{)3268}$	$76\overline{)2736}$	$61\overline{)3965}$	$79\overline{)1264}$

II

If there is a remainder, do **not** express it as part of the quotient. Prove your answer for each example. It is better to solve one example and prove it than to solve two examples without proof.

1. $2464 \div 22 = ?$
2. $3564 \div 33 = ?$
3. $2456 \div 92 = ?$
4. $5842 \div 63 = ?$
5. $7289 \div 29 = ?$
6. $3837 \div 49 = ?$
7. $5648 \div 59 = ?$
8. $7585 \div 65 = ?$
9. $7393 \div 84 = ?$
10. $6378 \div 61 = ?$
11. $5236 \div 58 = ?$
12. $1362 \div 19 = ?$
13. $1288 \div 14 = ?$
14. $1963 \div 39 = ?$
15. $2382 \div 69 = ?$
16. $1527 \div 28 = ?$
17. $1208 \div 27 = ?$
18. $1390 \div 25 = ?$
19. $125\overline{)7634}$
20. $112\overline{)8465}$
21. $105\overline{)5890}$
22. $128\overline{)1396}$
23. $144\overline{)6324}$
24. $231\overline{)8649}$
25. $119\overline{)3346}$
26. $129\overline{)2548}$
27. $148\overline{)6350}$

III

A 5th grade pupil good in long division should do four of these examples right and prove the work in 10 minutes.

$28\overline{)8204}$	$65\overline{)45825}$	$58\overline{)51736}$	$94\overline{)38634}$
$47\overline{)39997}$	$36\overline{)23076}$	$74\overline{)48100}$	$25\overline{)12075}$

Everyday Problems

1. When eggs were 53¢ a dozen, how many full dozens could I buy for $5.00, and how much change would remain?

2. At 56 lb. to the bushel, how many bushels in a load of shelled corn weighing 2300 lb.?

3. A farmer raised 3526 bushels of corn on 41 acres. What was the yield per acre?

4. 75 acres of Texas land were sold for $4875. How much was that an acre?

5. A Kansas farmer harvested 1578 bushels of wheat from a 75-acre field. What was the average per acre?

6. James picked from one tree 340 grapefruit of the size 64 to a box. How many boxes were there?

7. Fine apples are often packed 80 to a box. How many such boxes can be packed out of a pile containing 600 apples?

8. A man owns 8 horses which are fed 1 qt. of oats each 3 times a day. How many quarts at this rate will it require to feed his horses during the month of July? How many bushels? There are 32 qt. in a bushel.

9. The following weights represent loads of wheat taken to market, one load each day for 5 days:

1920 lb., 1620 lb., 2100 lb., 1840 lb., 2000 lb.

How many bushels were hauled on each load and how many altogether? There are 60 lb. in a bushel of wheat.

10. A Vermont farmer went to town with 18 one-gallon cans of maple sirup for which he received $25.20. What was his price per gallon?

1. The multiplier and multiplicand are called factors of the product. In $3 \times 6 = 18$, 3 and 6 are called factors of 18. Name two other factors of 18.

2. What are the factors of 24?

3. Name two sets of factors of $32.

4. Each of the above factors in examples 1, 2, and 3 is also a divisor.

5. A factor found in each of two or more numbers is said to be common and is called a **common factor** of these numbers. 2 is a common factor of 6 and 8, because 2 is a factor of both 6 and 8. 9 is a common factor of 18 and 27. Why?

6. Ability to see a large common factor of two or more numbers often makes problem solving short and easy.

Practice in Telling Common Factors

State the largest common factor of each of these groups.

	a	b	c	d
1.	16 and 24	6 and 9	12 and 15	18 and 24
2.	24 and 36	15 and 18	20 and 30	15 and 45
3.	54 and 63	48 and 54	32 and 36	27 and 36
4.	45 and 54	19 and 57	48 and 72	48 and 96
5.	18 and 32	24 and 32	36 and 48	45 and 60
6.	72 and 96	32 and 48	48 and 56	12 and 36
7.	84 and 96	33 and 44	27 and 18	25 and 50
8.	63 and 72	27 and 72	36 and 60	13 and 26
9.	50 and 75	35 and 75	56 and 96	36 and 63
10.	12 and 48	9 and 36	8 and 72	18 and 81
11.	34 and 17	16 and 64	77 and 121	44 and 48
12.	121 and 132	144 and 156	110 and 99	84 and 91

How to Recognize Certain Factors in Large Numbers

In order to shorten work it is often useful to know at a glance whether 2, 3, 4, 5, 6, 8, 9, or 10 is a factor of a given large number. To do this you need to learn the following **factor tests.**

1. 2 is a factor of every even number.

An even number is one that ends in 0, 2, 4, 6, or 8. Is 2 a factor of 28? of 39?

2. 3 is a factor of a number if it is a factor of the sum of the **digits** of that number.

3 is a factor of 2832 because it is a factor of 15, the sum of $2+8+3+2$ (the digits of 2832). Try it.

3. 4 is a factor of a number if it is a factor of the number represented by the last two digits, or if the number ends in two zeros.

4 is a factor of 1736 because 4 is a factor of 36. Try it. Is 4 a factor of 1882? of 1920? of 2992?

4. 5 is a factor of every number ending in 0 or 5.

5. 6 is a factor of every **even** number which can be divided by 3.

$6=3\times2$. Therefore, if 3 is contained in an even number, such as 396, 6 is contained in it. Try it.

6. 8 is a factor of a number if it is a factor of the number represented by the last three digits.

8 is a factor of 6728 because 8 is a factor of 728. Try it.

7. 9 is a factor of a number if it is a factor of the sum of the digits of that number.

9 is a factor of 1728 because 9 is a factor of 18, the sum of $1+7+2+8$ (the digits of 1728). Try it.

8. 10 is a factor of every number ending in 0.

Try all the tests with short division on these numbers.

	a	b	c	d	e
1.	728	963	1424	386	1744
2.	362	250	6400	604	4356
3.	616	841	1256	322	6282
4.	519	622	2006	343	3428

Special Methods in Division

I. When the divisor ends in one, two, or three zeros, cut off from the right side of both divisor and dividend as many digits as there are zeros in the divisor. Then proceed as in short division.

$$2\cancel{0}\overline{)34\cancel{6}}\quad 17 \text{ Remainder, 6.} \qquad 3\cancel{00}\overline{)25\cancel{89}}\quad 8 \text{ Remainder, 189.}$$

1. Divide these numbers by 20, 200, by 2000.

7840 7486 6484 3578 3600 9624 4384

2. Divide the following by 70, by 700, by 7000.

14264 15030 24385 16200 9648 52682

II. When the dividend and divisor have a common factor the removal of which changes the example to one in short division, proceed in this way:

$$8448 \div 96 = \overset{704}{\cancel{8448}} \div \overset{8}{\cancel{96}} = 88.$$

HINT.—Remove the common factor 12 from the dividend and the divisor. Show that dividing 704 by 8 must give the same quotient as dividing 8448 by 96.

Examples for Practice

Before dividing reduce each of the following long division examples to one in short division by removing the common factor as suggested in the previous example.

1. $36032 \div 64 = ?$	9. $15444 \div 36 = ?$
2. $17475 \div 15 = ?$	10. $53634 \div 42 = ?$
3. $26215 \div 49 = ?$	11. $81312 \div 28 = ?$
4. $65205 \div 81 = ?$	12. $37464 \div 24 = ?$
5. $53640 \div 72 = ?$	13. $13860 \div 45 = ?$
6. $78948 \div 54 = ?$	14. $36708 \div 84 = ?$
7. $12789 \div 63 = ?$	15. $92624 \div 56 = ?$
8. $35640 \div 99 = ?$	16. $58212 \div 77 = ?$

Cancellation

1. Cancellation is a method of showing the omission of common factors from the dividend and divisor or from the factors of the dividend and divisor in an indicated division.

2. The sign is an oblique mark (/) written across the number cancelled.

3. Cancellation often reduces a long and complicated computation to a short and easy mental operation.

4. A division operation may be shown thus: (1) $84 \div 14$; (2) $14\overline{)84}$, read 14 into 84; (3) $\frac{84}{14}$, read 84 divided by 14.

5. When the division takes the form of the last, cancellation is usually employed. There is no good reason why you should not use it in all indicated divisions if you understand the meaning of what you are doing.

6. Divide $8 \times 4 \times 28$ by 128.

$$\frac{\overset{1}{\cancel{8}} \times \overset{1}{\cancel{4}} \times \overset{7}{\cancel{28}}}{\underset{\underset{\underset{1}{\cancel{4}}}{\cancel{16}}}{\cancel{128}}} = \frac{7}{1} = 7.$$

Remove the common factor of 8 and 128. You have 1 and 16. Treat 4 and 16 in the same manner. You have 1 and 4. Next remove the common factor from 28 and 4. You have 7 and 1. Then multiply the factors not cancelled in the dividend. In this case there is only the factor 1 in the divisor. It is not necessary to write 1 in the dividend or divisor when you have cancelled, but remember that neither dividend nor divisor is ever 0.

Examples for Practice

Use cancellation as far as possible.

1. Divide $36 \times 48 \times 15$ by $30 \times 12 \times 9$.
2. Divide 64×128 by 8×4.
3. Divide $72 \times 96 \times 48$ by 1728.
4. Divide 35×24 by 144.
5. Divide 27×144 by 54.
6. Divide $16 \times \$5$ by 8.
7. Divide $25 \times 200 \times 18$ by 7500.
8. Divide $3 \times 60¢$ by 45¢.
9. Divide $7 \times 8 \times 1728$ cu. in. by 231 cu. in.
10. Make a problem whose solution would require the operations shown in example 6.
11. Make a good problem whose solution is indicated in example 8.

12. $\frac{25 \times 36}{75} = ?$

13. $\frac{100 \times 48 \times 22}{200 \times 16 \times 11} = ?$

Solving Problems by Using Cancellation

In many communities farmers pay for their groceries or other merchandise with produce such as butter, eggs, or lard, which they take to the general store.

Good problem solvers learn **to do** by first **finding out how.**

1. How many dozen eggs at 45¢ a dozen must I have to pay for 5 lb. of coffee at 48¢ a lb.? (July 1919 prices).

Thinking.—The cost of 5 lb. of coffee at 48¢ a lb. is the value of all the eggs at 45¢ a dozen.

Statement and computation.

$$\text{The number of dozen} = \frac{\cancel{5} \times \overset{16}{\cancel{48}}}{\underset{\underset{3}{\cancel{9}}}{\cancel{45}}} = \frac{16}{3} \text{ or } 5\tfrac{1}{3}.$$

2. A boy exchanged at the grocery store 24 lb. of tomatoes from his thrift garden at 6¢ a lb. for sugar at 12¢ a lb. for his mother (price in July, 1919). How much sugar did he take home?

3. How many pounds of butter at 45¢ a lb. will it require to pay for 3 lb. of tea at 60¢ a lb.?

4. How many crates of 16 quart boxes each can I fill from 4 two-gallon buckets full of cherries? What are the cherries worth at 15¢ a box?

5. How much lard at 25¢ a lb. must a farmer's wife give for 10 yd. of gingham at 70¢ a yard?

6. A man went to market with 15 sacks of wheat, each containing on an average 116 lb. How many bushels of 60 lb. each in the load? How much money did the man get for his wheat at $2.50 a bushel?

I

Finding Fractional Parts of Numbers

1. $\frac{5}{6} \times 24 = ?$ (Read $\frac{5}{6}$ of 24.)

Think, "$5 \times \frac{1}{6}$ of $24 = 5 \times 4$." Say or write 20.

2. $\frac{7}{8} \times 24 = ?$
3. $\frac{11}{12} \times 24 = ?$
4. $\frac{5}{9} \times 18 = ?$
5. $\frac{6}{7} \times 42 = ?$
6. $\frac{5}{8} \times 40 = ?$
7. $\frac{3}{4} \times 40 = ?$
8. $\frac{3}{4} \times 28 = ?$
9. $\frac{5}{12} \times 84 = ?$
10. $\frac{5}{16} \times 32 = ?$
11. $\frac{3}{4} \times 36$ in. $= ?$
12. $\frac{5}{8} \times 56$ bu. $= ?$
13. $\frac{5}{6} \times 36$ mi. $= ?$
14. $\frac{7}{9} \times \$27 = ?$
15. $\frac{11}{12} \times 24$ in. $= ?$
16. $\frac{5}{24} \times \$48 = ?$
17. $\frac{3}{5} \times 60¢ = ?$
18. $\frac{3}{8} \times 72$ ft. $= ?$
19. $\frac{7}{10} \times 80¢ = ?$

II

Multiplication Facts

Write these products in two minutes:

3	2	3	0	7	9	9	7	6	8	9	5	5	6	4
4	0	7	6	8	6	7	7	7	9	9	9	5	6	0

3	6	4	6	8	4	3	3	4	0	1	5	4	9	4
3	8	8	3	5	4	2	9	7	2	1	2	9	2	5

3	8	4	6	6	0	2	7	5	8	9	9	8	8	8
7	2	0	9	5	0	3	6	5	8	0	2	7	6	4

III

In 6 minutes a 5th grade pupil should do right 4 of these multiplication examples.

9524	2143	9786	4079	6785	4921	9809	5785
58	89	45	57	96	73	42	24

IV

Add by grouping those fractions whose sum is one.

1.	2.	3.	4.	5.	6.	7.	8.
$\frac{1}{4}$	$\frac{7}{8}$	$\frac{2}{3}$	$\frac{5}{12}$	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{5}{8}$	$\frac{5}{16}$
$\frac{1}{2}$	$\frac{1}{3}$	$\frac{7}{8}$	$\frac{2}{12}$	$\frac{3}{4}$	$\frac{1}{6}$	$\frac{2}{8}$	$\frac{3}{16}$
$\frac{3}{4}$	$\frac{2}{3}$	$\frac{1}{8}$	$\frac{7}{12}$	$\frac{1}{3}$	$\frac{5}{6}$	$\frac{3}{8}$	$\frac{13}{16}$

9.	10.	11.	12.	13.	14.
$2\frac{1}{2}$	$4\frac{1}{4}$	$3\frac{7}{8}$	$4\frac{1}{3}$	$6\frac{1}{8}$	$12\frac{1}{2}$
$6\frac{1}{2}$	$5\frac{3}{4}$	$4\frac{1}{4}$	$5\frac{3}{4}$	$7\frac{3}{8}$	$25\frac{1}{2}$
$7\frac{1}{2}$	$2\frac{1}{2}$	$5\frac{1}{8}$	$6\frac{2}{3}$	$2\frac{1}{2}$	$30\frac{3}{4}$
$8\frac{1}{2}$	$4\frac{1}{2}$	$6\frac{1}{4}$	$7\frac{1}{4}$	4	42

V

Reviewing Facts Already Learned

1. How many 3rds in 2? sixths in 4? halves in 8? 4ths in 3? 12ths in 2? 5ths in 5?

2. How many pt. in 2 qt.? pk. in 3 bu.? qt. in 4 gal.? quarters in \$2? dimes in \$3? nickels in 50¢? pennies in a quarter dollar? days in 3 wk.? min. in 2 hr.?

3. $\frac{3}{4}$ doz. = how many ones? $\frac{2}{3}$ min. = how many sec.? $\frac{3}{8}$ day = how many hr.? $\frac{1}{2}$ gal. = how many pt.? $\frac{1}{2}$ bu. = how many qt.?

4. $\frac{1}{2}$ pt. = what part of a qt.? 1 qt. = what part of a gal.? 1 day = what part of a wk.? 1000 lb. = what part of a ton? 50¢ = what part of a dollar? 8 hr. = what part of a day?

5. 2 for 5¢ = 6 for ? 3 for a dime = 12 for ? 6 for 25¢ = how many for \$1? At 50¢ a doz. = how many for 25¢? At \$1.00 a doz. = how many for \$1.50?

VI

Counting by Common Measures

1. Count by 2's to 20 saying 2 pt. =1 qt., 4 pt. =2 qt., 6 pt. =3 qt., etc.

2. Count by 3's to 30 saying 3 ft. =1 yd., 6 ft. =2 yd., 9 ft. =3 yd., etc.

3. Count by 4's to 40 saying 4 qt. =1 gal., 8 qt. =2 gal., 12 qt. =3 gal., etc.

4. Count by 5's to 50 saying 5 pennies =1 nickel, 10 pennies =2 nickels, 15 pennies =3 nickels, etc.

VII

Writing the Missing Number

Write the answers first by lines, then on another sheet by columns. Compare the two sets of answers. Time your work today. Try again tomorrow.

	a	b	c
1.	$8\times 4=\ ?$	$3\times\ ?=12$	$9+4=\ ?$
2.	$7-\ ?=3$	$?-4=14$	$8\times\ ?=56$
3.	$64\div\ ?=8$	$7+\ ?=13$	$?+8=21$
4.	$19-\ ?=12$	$3\times\ ?=27$	$15+8=\ ?$
5.	$6\times\ ?=42$	$?\div 4=6$	$18\div\ ?=6$
6.	$63\div 7=\ ?$	$15\div\ ?=3$	$9\times 6=\ ?$
7.	$54\div 6=\ ?$	$45-\ ?=25$	$23-\ ?=13$
8.	$18+\ ?=28$	$72\div\ ?=9$	$81\div\ ?=9$
9.	$9\times\ ?=45$	$7\times\ ?=63$	$8\times\ ?=72$
10.	$15+\ ?=25$	$100-\ ?=75$	$50+\ ?=100$
11.	$\frac{3}{4}\times 24=\ ?$	$\frac{5}{8}\times 32=\ ?$	$\frac{8}{9}\times 72=\ ?$
12.	$\frac{5}{6}\times 24=\ ?$	$\frac{7}{8}\times 24=\ ?$	$\frac{5}{9}\times 27=\ ?$

Problem Test with Figuring

A good 5th grade pupil should solve six in 30 minutes.

1. If I have $7840, how much must I borrow to pay for a farm costing me $10,000?

2. John's father owns 100 acres. In 1920 he had 15 acres in wheat, 20 acres in corn, 18 acres in oats, and 17 acres for hay. The barn, barnyard, house, yard, and garden cover 2 acres, the orchard 2 acres. How many acres are there in the rest of the farm?

3. A grocer bought 12 bbl. of Ben Davis apples at $3.25 a bbl., 15 bbl. of Jonathans at $3.75 a bbl., and 9 bbl. of Baldwins at $3.75 a bbl. Find the total cost.

4. A farmer has 9 bales of cotton, weighing 4797 pounds. The first five bales weigh 482, 496, 530, 548, and 553 pounds. What is the average weight of the other bales? What are the 9 bales worth at 35¢ a pound? (1919 price.)

5. Sarah's term report had the following grades: Arithmetic, 90; Geography, 95; Reading, 92; Writing, 96; Language, 91; Nature-Study, 90; History, 90. What was her average?

6. A wagon and its load of potatoes weigh 3460 lb.; the empty wagon weighs 1420 lb. What should the farmer receive for his potatoes at $1.60 a bushel (1918 price), counting 60 lb. to the bushel?

7. A passenger train and a freight train leave Casey, Illinois, at the same time. If the first train travels 40 miles an hour and the second 18 miles an hour, how far apart will they be in 4 hours if they travel in the same direction? How far in opposite directions?

Time, 30 minutes

Write a good sentence in which you tell what you must do to solve each of these problems.

1. Given the sum of two numbers and one of them, find the other number.

2. Given the number of cultivated acres in a farm and the number not cultivated, find the size of the farm.

3. Given the quotient and the dividend, find the divisor.

4. Given the remainder and the subtrahend, find the minuend.

5. Given the number of thrift stamps I can save in a week and the number of thrift stamps in one war savings stamp, find how many war savings stamps I can buy in two months.

6. Given how many pupils are present and the number absent, find how many belong in the room.

7. Given the multiplier and the product, find the multiplicand.

8. Given the selling price of an article and its cost, find the gain.

9. Given the selling price of an article and its cost, find the loss.

10. Given the area of an oblong and the length, find width.

11. Given the number of problems a girl had right and the number she tried, find how many she missed.

12. Given the cost of a dozen eggs, find the cost of one egg.

Completing the Problem

Tell what other fact or facts are needed to complete each of these problems.

1. Given the daily cost of my lunch, find the cost during October.

2. Given the merchant's cost of a suit of clothes, find his selling price.

3. Knowing that 3 letters are to be stamped and registered, find the total cost.

4. Knowing the length of an oblong garden, find the area.

5. Knowing the value of a bushel of wheat, find the value of the wheat of a 10 acre field.

6. Given the sum of two numbers, find the larger one.

7. Given the price of a pound of cotton, find the value of a bale.

8. John said, "I am 3 years older than my brother." What else must you know before you can find out John's age?

9. Knowing how much money Robert lost, how can you find what he has left?

10. Knowing how much money a boy has saved for a bicycle, how can you find how much more he must have to pay for it?

11. If a farmer knows how much money he received for a hog, what else must he know to find out its weight?

12. If Frank knows how many square feet in an oblong thrift garden, what more must he know to find the length?

These are **incomplete** problems. In each one tell what you must know to complete the problem. Then solve it.

1. John sold 63 newspapers on Saturday. How much money did he receive for them?

2. The daily cost of my lunch is 15¢. Find the cost during October.

3. The merchant's cost of a suit of clothes is $20. Find his selling price.

4. I have 3 letters to be stamped and registered. Find the total cost.

5. The length of a rectangular garden is 50 ft. Find the area.

6. A bushel of wheat is worth $2. Find the value of the wheat in a 10 acre field.

7. The sum of two numbers is 53. Find the smaller one.

8. When the price of a pound of cotton is 20¢, find the value of a bale.

9. John said, "I am 3 years older than my brother." How old is John?

10. Robert lost 10¢. How much has he left?

11. A boy has saved $12 for a bicycle. How much more must he have to pay for it?

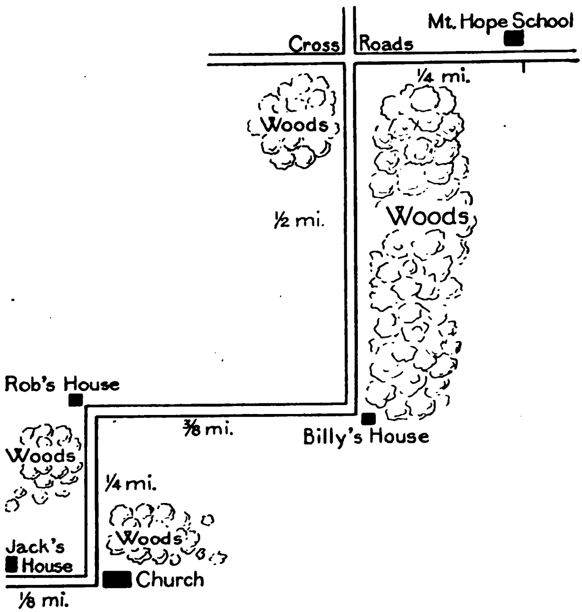
12. A man received 14¢ a lb. for his hogs. How much money did he get for them?

13. There are 1000 sq. ft. in an oblong thrift garden. How wide is it?

14. William sold 68 of his newspapers. How many had he at first?

CHAPTER III

COMMON FRACTIONS



Scale.—$\frac{1}{2}$ **in.** = $\frac{1}{8}$ **mi.**

When the 5th grade class in arithmetic began the study of fractions, the teacher asked the boys and girls to draw maps showing the route from their home to school. The teacher said they would use these maps in learning more about fractions.

This is the map which Jack drew. He had two boy friends who went with him to school every morning.

1. Write in a line all the fractions on the map of the previous page.

2. Which is the largest of these fractions? Which is the smallest?

3. If $\frac{1}{8}$ mi. is $\frac{1}{2}$ in. on the map, with your rule* draw a straight line which shows 1 mi.

4. Divide the line which you drew into 8 equal parts.

(1) What part of this line shows the distance from Jack's house to Church?

(2) What part of this line shows the distance from Rob's house to Billy's house?

5. If $\frac{1}{4}$ mi. is 1 in. on the map, draw a line which shows 1 mi.

6. Divide this line into 4 equal parts.

(1) What part shows the distance from the Church to Rob's house?

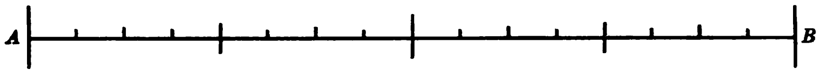
(2) What part shows the distance from Billy's house to the crossroads?

(3) What part shows the distance from the crossroads to the schoolhouse?

7. If you call each line which you drew in problems 3 and 5 one, then the different parts which you have shown in these lines are fractions. Write all the fractions which you have shown. Compare them with those in problem 1.

8. We may say then, "A fraction is one or more of the equal parts of a unit, or one thing."

* NOTE.—Frequent use of the foot rule with the inch divided to 8ths or 16ths will help you to understand much work with fractions.



9. Draw a line exactly like *AB*. Show on it these fractions. If you need to do so, draw more than one line.

$\frac{1}{16}$ $\frac{1}{8}$ $\frac{1}{4}$ $\frac{1}{2}$ $\frac{3}{16}$ $\frac{3}{8}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{5}{8}$

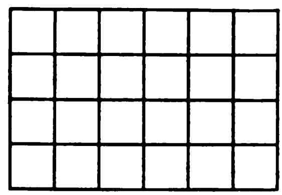
$\frac{5}{16}$ $\frac{8}{8}$ $\frac{7}{8}$ $\frac{7}{16}$ $\frac{4}{8}$ $\frac{8}{16}$ $\frac{15}{16}$ $\frac{13}{16}$ $\frac{16}{16}$

10. Draw a figure exactly like D. If you need to do so, draw several such figures.

11. What part of the whole figure does a small square represent?

12. Show by shading or otherwise:

(*a*) $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$, $\frac{4}{4}$.
(*b*) $\frac{1}{6}$, $\frac{2}{6}$, $\frac{4}{6}$, $\frac{5}{6}$.
(*c*) $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{8}$, $\frac{5}{8}$.
(*d*) $\frac{1}{12}$, $\frac{5}{12}$, $\frac{9}{12}$, $\frac{11}{12}$.
(*e*) $\frac{1}{24}$, $\frac{5}{24}$, $\frac{12}{24}$, $\frac{23}{24}$.



D

13. Write other fractions which you can show on figure D.

14. In example 9 the whole line *AB* is the unit (one thing). In example 10 the whole figure D is the unit. The fractions which you showed above are one or more equal parts of these units.

15. A fraction is a number which shows one or more of the equal parts of a unit.

16. In $\frac{3}{8}$, 3 is the **numerator** (the number above the line); 8 is the **denominator** (the number below the line).

17. Name the numerator and denominator of these fractions: $\frac{5}{8}$, $\frac{7}{12}$, $\frac{3}{16}$, $\frac{15}{16}$, $\frac{2}{3}$.

18. The denominator (namer) shows into how many equal parts the unit was divided. It also names the equal parts. In $\frac{3}{4}$, 4 is the number of parts into which the unit is divided, and fourths is the name of these parts.

19. The numerator (numberer) shows how many equal parts there are in the fraction.

20. The **numerator** and **denominator** taken together are called the **terms** of the fraction.

21. A **unit fraction** or a **fractional unit** is a fraction whose numerator is 1; as $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, etc.

22. Name all the fractional units found on this page.

23. Write a very small fractional unit, a very large one.

24. What does a large denominator show? What does a small one show?

Changing Fractions to Smaller Units

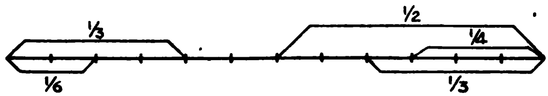
1. Anna had a piece of ribbon $\frac{1}{3}$ yd. long. She cut it into two equal parts for book marks. What was the size of each mark? How many book marks did she have?

2. John cut half an apple into two equal parts. What was the size of each part?

3. If you cut $\frac{1}{2}$ into two equal parts, what is each part called?

4. Did Anna have as much ribbon after cutting as before? Did John have as much apple after cutting as before?

5. Read problems 1, 2, and 3 once more to see if this statement is true: "The parts (units) after cutting are smaller and there are more of them."



This figure shows halves, thirds, fourths, sixths, and twelfths. Study it and from it supply the terms missing below.

	a	b	c	d	e
1.	$1=\frac{\ }{3}$	$1=\frac{\ }{6}$	$1=\frac{\ }{12}$	$\frac{3}{3}=\frac{\ }{6}$	$\frac{3}{3}=\frac{\ }{12}$
2.	$\frac{1}{3}=\frac{\ }{6}$	$\frac{1}{3}=\frac{\ }{12}$	$\frac{2}{3}=\frac{\ }{6}$	$\frac{2}{3}=\frac{\ }{12}$	$\frac{1}{6}=\frac{\ }{12}$
3.	$\frac{2}{6}=\frac{\ }{12}$	$\frac{4}{6}=\frac{\ }{12}$	$\frac{6}{6}=\frac{\ }{12}$	$\frac{3}{4}=\frac{\ }{12}$	$\frac{4}{4}=\frac{\ }{12}$
4.	$\frac{1}{2}=\frac{\ }{4}$	$\frac{1}{2}=\frac{\ }{6}$	$\frac{1}{2}=\frac{\ }{12}$	$\frac{3}{6}=\frac{\ }{12}$	$\frac{5}{6}=\frac{\ }{12}$

1. Into how many equal parts must you cut $\frac{1}{4}$ to get $\frac{1}{12}$? How many such twelfths will there be? Prove your answer with the figure above.

2. How many times as large as $\frac{1}{4}$ is $\frac{1}{2}$? Therefore, I can cut $\frac{1}{2}$ into __ fourths?

3. How would you cut $\frac{1}{6}$ to get 12ths? to get 24ths? to get 18ths?

4. If $\frac{1}{6}$ = two 12ths, then $\frac{5}{6}=5\times$ __ 12ths. Prove your answer with the figure.

5. If $\frac{1}{6}$ = four 24ths, then $\frac{5}{6}=5\times$ __ 24ths.

6. How can you change halves, thirds, fourths, eighths, and twelfths to twenty-fourths?

7. How can you change halves, thirds, fourths, eighths, and 16ths to 32nds?

Look at your answers to the examples on this page to see if this statement is true: "If a part after cutting is to be $\frac{1}{2}$ as large as the part before cutting, then the number of parts after cutting will be 2 times as many as the number of parts before cutting."

If a part after cutting is to be $\frac{1}{3}$ or $\frac{1}{4}$ as large as the part before cutting, how many parts will there be after cutting?

With the help of these statements supply the missing numerators in the next exercise.

Practice

Do not use pencil.

1. $\frac{1}{2} = \frac{\quad}{4}$, or $\frac{\quad}{6}$, or $\frac{\quad}{8}$, or $\frac{\quad}{16}$?
2. $\frac{1}{4} = \frac{\quad}{8}$, or $\frac{\quad}{12}$, or $\frac{\quad}{24}$, or $\frac{\quad}{32}$?
3. $\frac{1}{3} = \frac{\quad}{6}$, or $\frac{\quad}{9}$, or $\frac{\quad}{12}$, or $\frac{\quad}{24}$?
4. $\frac{3}{4} = \frac{\quad}{8}$, or $\frac{\quad}{12}$, or $\frac{\quad}{24}$, or $\frac{\quad}{32}$?
5. $\frac{2}{3} = \frac{\quad}{6}$, or $\frac{\quad}{9}$, or $\frac{\quad}{12}$, or $\frac{\quad}{24}$?
6. $\frac{3}{8} = \frac{\quad}{16}$, or $\frac{\quad}{24}$, or $\frac{\quad}{32}$, or $\frac{\quad}{48}$?
7. $\frac{5}{8} = \frac{\quad}{16}$, or $\frac{\quad}{24}$, or $\frac{\quad}{32}$, or $\frac{\quad}{48}$?
8. $\frac{5}{12} = \frac{\quad}{24}$, or $\frac{\quad}{36}$, or $\frac{\quad}{48}$, or $\frac{\quad}{60}$?
9. Change these fractions to 24ths.

$\frac{1}{2}$, $\frac{7}{8}$, $\frac{1}{12}$, $\frac{5}{12}$, $\frac{3}{8}$, $\frac{2}{3}$, $\frac{1}{6}$, $\frac{5}{8}$, $\frac{5}{6}$, $\frac{11}{12}$, $\frac{1}{3}$, $\frac{7}{12}$, $\frac{3}{4}$, $\frac{1}{8}$.

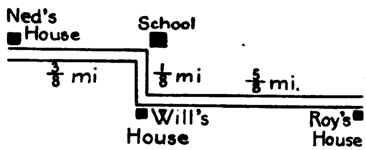
What change was made in each case in the size of the unit? In the number of units? In the value of the fraction?

10. Change these fractions to 32nds.

$\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{5}{8}$, $\frac{5}{16}$, $\frac{9}{16}$, $\frac{7}{8}$, $\frac{11}{16}$, $\frac{15}{16}$.

11. What was done with both numerator and denominator of each of the fractions in No. 10?

Measuring Fractions



1. Will wished to compare the distance from Ned's house to school with the distance from his house to school. His teacher told him that he should measure the distance from Ned's house ($\frac{3}{8}$ mi.) with his distance ($\frac{1}{8}$ mi.) just as he would measure a 3 foot line with a foot rule.

(*a*) How often does a 3 ft. line contain 1 ft.? How often does $\frac{3}{8}$ mi. contain $\frac{1}{8}$ mi.?

1 ft. and $\frac{1}{8}$ mi. are called **units of measure.**

(*b*) How often does $\frac{5}{8}$ mi. contain $\frac{1}{8}$ mi.?

(*c*) Compare the distance between Will's house and Roy's house with the distance from Will's house to school.

1. Draw a figure exactly like this one.

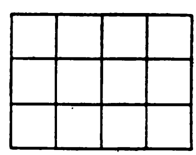
Call the line *AD* 1.

(*a*) Show $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ if the smallest part of the line is $\frac{1}{16}$.

(*b*) Show $\frac{3}{4}$, $\frac{3}{8}$, $\frac{5}{8}$, $\frac{7}{16}$, $\frac{4}{8}$, $\frac{7}{8}$, $\frac{13}{16}$, $\frac{5}{16}$, $\frac{11}{16}$, $\frac{8}{8}$.

(*c*) Which fraction in *b* can you measure with $\frac{1}{4}$?

(*d*) Which fractions in *b* can you measure with $\frac{1}{8}$? Which ones with $\frac{1}{16}$?



2. Draw a figure exactly like this one. Call the whole figure 1.

(*a*) Show $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{12}$.

(*b*) Show $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{5}{12}$, $\frac{7}{12}$, $\frac{11}{12}$, $\frac{4}{6}$, $\frac{8}{12}$, $\frac{3}{6}$.

(*c*) Which fractions in *b* can you measure with $\frac{1}{3}$?

(*d*) Which fractions in *b* can you measure with $\frac{1}{12}$, which with $\frac{1}{6}$?

(*e*) What is the largest unit of measure (fractional unit) named in *a*?

(*f*) Can you find a larger unit of measure than those named in *a*?

3. What is the unit of measure in each of these fractions: $\frac{3}{4}$, $\frac{7}{12}$, $\frac{5}{8}$, $\frac{11}{12}$, $\frac{9}{16}$, $\frac{7}{8}$, $\frac{5}{6}$, $\frac{5}{12}$, $\frac{11}{16}$, $\frac{7}{24}$, $\frac{7}{16}$, $\frac{15}{16}$? Which of the fractions just named have the same unit of measure?

4. How often does $\frac{7}{16}$ contain $\frac{1}{16}$? $\frac{11}{12}$ contains $\frac{1}{12}$ how often? How often does $\frac{18}{16}$ contain $\frac{1}{16}$?

Finding the Common Measure of Two or More Fractions

1. On page 52 you found that you could measure $\frac{3}{8}$ mi. and $\frac{5}{8}$ mi. with $\frac{1}{8}$ mi. $\frac{1}{8}$ mi. is called a **common measure** of $\frac{3}{8}$ mi. and $\frac{5}{8}$ mi. because each of these fractions contains $\frac{1}{8}$ mi. an exact number of times.

2. You also found other fractional units (See page 52) each of which was a measure of two or more fractions. In such case each of these units was a **common** measure.

3. What is the common measure of $\frac{5}{8}$ and $\frac{7}{8}$? of $\frac{5}{12}$ and $\frac{7}{12}$? of $\frac{3}{16}$ and $\frac{7}{16}$? Can you add $\frac{5}{8}$ and $\frac{7}{8}$? $\frac{3}{16}$ and $\frac{7}{16}$? Why?

4. Look at some fractions to see if this statement is true.

The fractional unit is always a common measure of all fractions which have the same denominator as the unit.

5. Fractions with the same denominator are called **like** fractions; as $\frac{3}{8}$ and $\frac{7}{8}$. Write 3 other like fractions.

6. Unlike fractions are those with different denominators; as, $\frac{3}{4}$ and $\frac{5}{6}$. Such fractions do not have the same fractional unit.

7. Name 3 unlike fractions. Can you add these fractions? Why? Can you subtract them? Why?

8. When Jack wished to know how far it was from his house to Mt. Hope School (See page 46), he needed to know how to change to **like** fractions those which are **unlike.**

9. To do this he needed to know how to find the common measure of the fractions which he wished to add.

10. What is the common measure of $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$?

Try $\frac{1}{8}$. Is $\frac{1}{8}$ a measure of $\frac{1}{4}$? See figure I. Is $\frac{1}{8}$ a measure of $\frac{1}{2}$? See figure I. Then $\frac{1}{8}$ is a common measure of $\frac{1}{8}$, $\frac{1}{4}$, and $\frac{1}{2}$.

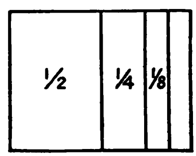


Fig. I

11. Find the fractional unit which is a common measure of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$.

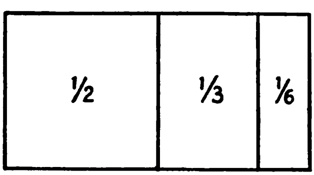


Fig. II

Always try first the smallest fractional unit of the given fractions. In this example it is $\frac{1}{6}$.

Is $\frac{1}{6}$ a measure of $\frac{1}{3}$? See figure II.

Is $\frac{1}{6}$ a measure of $\frac{1}{2}$? See figure II.

Then $\frac{1}{6}$ is a common measure of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$.

Observe that 6 contains 2 and 3.

12. Find the common measure of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{12}$.

Which fractional unit should you try first as a measure? Why?

Is $\frac{1}{12}$ a measure of $\frac{1}{6}$? See figure III.

Is $\frac{1}{12}$ a measure of $\frac{1}{4}$? See figure III.

Is $\frac{1}{12}$ a measure of $\frac{1}{2}$? See figure III.

Then $\frac{1}{12}$ is a common measure of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{12}$.

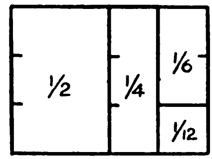


Fig. III

Observe that 12 contains 2, 4, and 6.

13. Find the common measure of $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{12}$.

14. Find the common measure of $\frac{1}{3}$ and $\frac{1}{4}$.

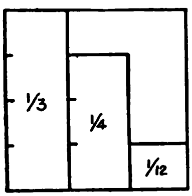


Fig. IV

Which fractional unit do you try first?

Is $\frac{1}{4}$ a measure of $\frac{1}{3}$? See figure IV.

Then try $\frac{1}{2}$ of $\frac{1}{4}$, or $\frac{1}{8}$. Is $\frac{1}{8}$ a measure of $\frac{1}{3}$? See figure IV.

Then try $\frac{1}{3}$ of $\frac{1}{4}$ or $\frac{1}{12}$. Is $\frac{1}{12}$ a measure of $\frac{1}{3}$? See figure IV.

Is $\frac{1}{12}$ a measure of $\frac{1}{4}$?

Then $\frac{1}{12}$ is a common measure of $\frac{1}{3}$ and $\frac{1}{4}$.

Observe that 12 contains 3 and 4.

15. With the help of figure V find the common measure of $\frac{1}{4}$ and $\frac{1}{12}$; of $\frac{1}{8}$ and $\frac{1}{12}$; of $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{12}$; of $\frac{1}{6}$, $\frac{1}{8}$, and $\frac{1}{12}$; of $\frac{1}{4}$ and $\frac{1}{6}$; of $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{8}$; of $\frac{1}{6}$, $\frac{1}{8}$, $\frac{1}{12}$, and $\frac{1}{24}$.

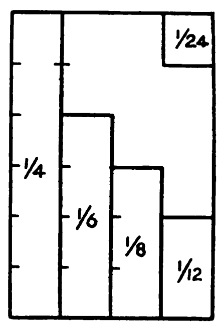


Fig. V

To find a common measure of two or more fractions, find by inspection the smallest number which contains exactly each of the denominators. The fractional unit of this number is the common measure of the fractions.

16. Find by looking at the denominators a common measure of

(*a*) fourths and sixteenths.
(*b*) eighths, twelfths, and twenty-fourths.
(*c*) halves and thirds.
(*d*) sixteenths and thirty-seconds.
(*e*) thirds, eighths, and twelfths.
(*f*) halves, sixths, and twelfths.

Changing Unlike Fractions to Like Fractions

I. Find the common measure of the given fractions.

II. Then change these fractions to fractions with the denominator of the common measure.

Example. Change $\frac{3}{8}$ and $\frac{5}{12}$ to like fractions.

Think, "$\frac{1}{24}$ is the common measure of 12ths and 8ths. $\frac{1}{8}$ contains $\frac{1}{24}$ 3 times. Then $\frac{3}{8}$ contains $\frac{1}{24}$ 9 times."

Write or say, "$\frac{3}{8}=\frac{9}{24}$."

Think, "$\frac{1}{12}$ contains $\frac{1}{24}$ 2 times. Then $\frac{5}{12}$ contains $\frac{1}{24}$ 10 times."

Write or say, "$\frac{5}{12}=\frac{10}{24}$."

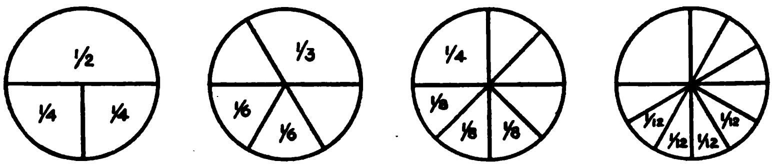
Using the method just explained, change the following to like fractions.

	a	b	c
1.	$\frac{5}{8}$, $\frac{2}{3}$	$\frac{7}{8}$, $\frac{3}{16}$	$\frac{1}{3}$, $\frac{7}{8}$, $\frac{11}{12}$
2.	$\frac{1}{3}$, $\frac{1}{4}$	$\frac{1}{8}$, $\frac{3}{4}$	$\frac{5}{6}$, $\frac{2}{3}$, $\frac{7}{12}$
3.	$\frac{2}{3}$, $\frac{1}{6}$	$\frac{2}{3}$, $\frac{3}{4}$	$\frac{1}{6}$, $\frac{7}{8}$, $\frac{3}{4}$
4.	$\frac{2}{3}$, $\frac{5}{9}$	$\frac{1}{2}$, $\frac{7}{10}$	$\frac{1}{2}$, $\frac{2}{3}$, $\frac{7}{8}$

Changing Fractions to Larger Units

A man traveled $\frac{1}{12}$ of his journey one day and $\frac{5}{12}$ of it the next day. What part of the journey did he travel in the two days?

When James did this problem, his answer was $\frac{6}{12}$. The teacher said it is always better to have answers in fraction problems in their simplest form. To do this James needed to know how to change fractions from smaller to larger units. This page and the next one will show you how he learned to do this.



$$\frac{1}{2}=\frac{2}{4} \quad = \quad \frac{3}{6} \quad = \quad \frac{4}{8} \quad = \quad \frac{6}{12}$$

1. Name the fractional unit (unit of measure) in $\frac{2}{4}$, in $\frac{3}{6}$, in $\frac{4}{8}$, in $\frac{6}{12}$.

2. Which is the largest fractional unit in the fractions in the previous example? Why?

3. Which is the largest fraction in example 1? Why?

4. To what other fraction is each of these fractions equal? See the figures.

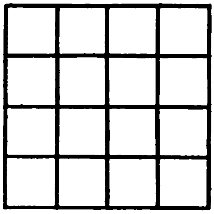
5. How can you change $\frac{6}{12}$ to $\frac{1}{2}$? $\frac{4}{8}$ to $\frac{1}{2}$? $\frac{3}{6}$ to $\frac{1}{2}$?

6. In each case in example 5, what was done with the **size** of the fractional unit? What with the **number** of fractional units?

7. Do you change the value of $\frac{6}{8}$ if you remove the factor 2, common to 6 and 8? See the figure.

8. With the help of the figures and by removing a common factor from the numerator and denominator, change to larger units: $\frac{3}{12}$, $\frac{9}{12}$, $\frac{8}{12}$, $\frac{4}{12}$.

9. Change $\frac{6}{8}$, $\frac{4}{8}$, $\frac{4}{6}$, $\frac{2}{8}$, $\frac{2}{6}$ to larger units.



10. Change $\frac{2}{16}$, $\frac{12}{16}$, $\frac{6}{16}$, $\frac{8}{16}$, $\frac{10}{16}$, $\frac{4}{16}$, $\frac{14}{16}$ to larger units. Prove your results with the help of this figure.

11. Supply the missing numerators.

(*a*) $\frac{24}{32}=\frac{\quad}{16}$, or $\frac{\quad}{8}$, or $\frac{\quad}{4}$.

(*b*) $\frac{16}{24}=\frac{\quad}{12}$, or $\frac{\quad}{6}$, or $\frac{\quad}{3}$.

(*c*) 12 oz. $=\frac{\quad}{16}$ lb., or $\frac{\quad}{8}$ lb., or $\frac{\quad}{4}$ lb.

12. Change $\frac{6}{8}$, $\frac{16}{32}$, $\frac{9}{12}$, $\frac{15}{20}$ to larger fractional units by omitting the largest common factor.

13. Changing a fraction to another fraction with the largest possible fractional unit is also called changing it to lowest terms.

14. To do this quickly you omit from both terms of the fraction the largest factor common to both. $\frac{18}{24}=\frac{3}{4}$, by omitting the factor 6 from both terms.

15. A fraction is in its lowest terms if its numerator and denominator do not have a common factor.

16. Look at each of these fractions. If it is in lowest terms, write it in a column which you may call A. If the fraction is not in lowest terms, change it to lowest terms, and write it in column B. Compare your columns with those of a classmate.

$\frac{1}{3}$	$\frac{3}{3}$	$\frac{1}{4}$	$\frac{2}{4}$	$\frac{3}{12}$	$\frac{5}{12}$	$\frac{6}{8}$	$\frac{3}{9}$	$\frac{1}{9}$	$\frac{5}{6}$
$\frac{1}{6}$	$\frac{6}{12}$	$\frac{2}{2}$	$\frac{10}{12}$	$\frac{8}{16}$	$\frac{1}{24}$	$\frac{12}{24}$	$\frac{9}{18}$	$\frac{13}{24}$	$\frac{15}{16}$
$\frac{4}{4}$	$\frac{11}{12}$	$\frac{9}{16}$	$\frac{24}{24}$	$\frac{20}{24}$	$\frac{11}{24}$	$\frac{7}{16}$	$\frac{10}{24}$	$\frac{21}{24}$	$\frac{7}{24}$

17. Reduce to lowest terms, that is, to largest fractional unit, each of these fractions.

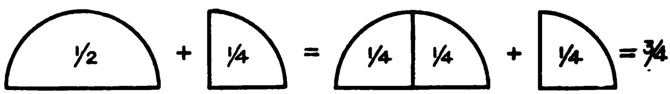
$\frac{32}{36}$	$\frac{36}{48}$	$\frac{25}{30}$	$\frac{18}{27}$	$\frac{15}{20}$	$\frac{21}{24}$	$\frac{18}{32}$	$\frac{24}{48}$
$\frac{18}{36}$	$\frac{25}{50}$	$\frac{30}{40}$	$\frac{15}{45}$	$\frac{18}{12}$	$\frac{30}{12}$	$\frac{50}{75}$	$\frac{75}{100}$

Addition of Fractions

1. For one doll dress it required $\frac{1}{2}$ yd. of goods; for another it took $\frac{3}{8}$ yd. How much was required for both dresses?

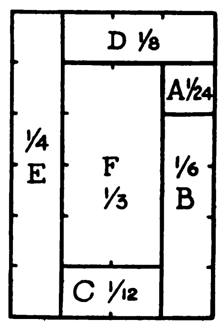
$\frac{1}{2} \quad + \quad \frac{3}{8} \quad = \quad \frac{4}{8} \quad + \quad \frac{3}{8} \quad =$

2. One boy ate $\frac{1}{2}$ of a small pie; another ate $\frac{1}{4}$ of it. How much did both eat?



3. Show by drawings how you can add these fractions: (*a*) $\frac{5}{8}+\frac{1}{4}$. (*b*) $\frac{1}{8}+\frac{3}{4}$. (*c*) $\frac{3}{8}+\frac{1}{4}$. (*d*) $\frac{1}{2}+\frac{1}{8}$.

4. Which figure in the diagram is a common measure of all the others?



5. How often does B contain it? How often does D contain it? How often does C? How often does E? How often does F?

6. If A is $\frac{1}{24}$, C is $\frac{\ }{24}$? D is $\frac{\ }{24}$? B is $\frac{\ }{24}$? E is $\frac{\ }{24}$? F is $\frac{\ }{24}$?

7. With the help of the diagram add $\frac{1}{12}$ and $\frac{1}{24}$; $\frac{1}{4}$ and $\frac{1}{6}$; $\frac{1}{8}$ and $\frac{1}{3}$; $\frac{1}{4}$, $\frac{1}{12}$, and $\frac{1}{24}$.

8. $\frac{1}{4}+\frac{1}{3}+\frac{1}{6}+\frac{1}{8}+\frac{1}{12}+\frac{1}{24}=?$

Instead of showing the common measure with diagrams whenever you wish to add fractions, it takes less time if you think them as like fractions with the help of the common measure and then add.

Adding Fractions

$\frac{1}{3}+\frac{1}{4}=?$ Think, "The common unit of measure is $\frac{1}{12}$. $\frac{1}{3}=\frac{4}{12}$. $\frac{1}{4}=\frac{3}{12}$. $\frac{4}{12}+\frac{3}{12}=\frac{7}{12}$." Write or say $\frac{7}{12}$.

Write the answers for these examples. Try to do them all right in 25 minutes.

1. $\frac{1}{2}+\frac{1}{8}=?$	**9.** $\frac{5}{6}+\frac{1}{12}=?$	**17.** $\frac{3}{4}+\frac{1}{8}=?$
2. $\frac{5}{8}+\frac{2}{8}=?$	**10.** $\frac{1}{3}+\frac{1}{6}=?$	**18.** $\frac{1}{2}+\frac{1}{6}=?$
3. $\frac{1}{3}+\frac{5}{12}=?$	**11.** $\frac{5}{12}+\frac{1}{4}=?$	**19.** $\frac{2}{3}+\frac{1}{6}=?$
4. $\frac{2}{3}+\frac{1}{9}=?$	**12.** $\frac{1}{9}+\frac{1}{3}=?$	**20.** $\frac{1}{5}+\frac{1}{10}=?$
5. $\frac{3}{5}+\frac{1}{10}=?$	**13.** $\frac{3}{4}+\frac{1}{16}=?$	**21.** $\frac{7}{8}+\frac{1}{16}=?$
6. $\frac{1}{2}+\frac{7}{16}=?$	**14.** $\frac{7}{8}+\frac{1}{12}=?$	**22.** $\frac{5}{16}+\frac{1}{32}=?$
7. $\frac{1}{3}$ yd. $+\frac{1}{2}$ yd. $=?$	**15.** \$$\frac{1}{4}$ + \$$\frac{1}{2}=?$	**23.** $\frac{3}{4}$ ft. $+\frac{1}{8}$ ft. $=?$
8. $\frac{1}{2}$ mi. $+\frac{3}{8}$ mi. $=?$	**16.** \$$\frac{1}{5}$ + \$$\frac{7}{10}=?$	**24.** $\frac{1}{4}$ bu. $+\frac{5}{8}$ bu. $=?$

Write 2 good problems for examples 23 and 24.

Add the following. Group in each example the fractions whose sum is 1.

1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**
$\frac{1}{2}$	$\frac{1}{8}$	$\frac{2}{5}$	$\frac{1}{9}$	$\frac{7}{8}$	$\frac{2}{3}$	$\frac{5}{8}$	$\frac{3}{4}$
$\frac{1}{3}$	$\frac{5}{12}$	$\frac{6}{10}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{11}{16}$	$\frac{5}{6}$
$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{3}$	$\frac{5}{9}$	$\frac{1}{8}$	$\frac{1}{3}$	$\frac{5}{16}$	$\frac{1}{6}$
$\frac{1}{2}$	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{1}{8}$	$\frac{2}{3}$	$\frac{1}{3}$	$\frac{3}{8}$	$\frac{1}{4}$
$\frac{2}{3}$	$\frac{7}{12}$	$\frac{1}{2}$	$\frac{7}{8}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{11}{12}$

Four girls planned to have dresses just alike for their dolls. One of the little girls was going to buy the material for all. The dolls were of different sizes. These were the amounts required for the dresses: $1\frac{1}{3}$ yd., $\frac{3}{4}$ yd., $\frac{1}{2}$ yd., and $\frac{1}{4}$ yd. How much material must be bought?

Improper Fractions and Mixed Numbers

1. What does $\frac{5}{4}$ yd. mean?

2. Does $\frac{5}{4}$ of one foot mean anything? Why?

3. How does $\frac{3}{4}$ yd. differ from $\frac{5}{4}$ yd.?

4. A fraction whose value is less than one is called a **proper** fraction. $\frac{2}{3}$, $\frac{7}{8}$ ft., $\frac{5}{12}$ yd., $\frac{1}{6}$ are proper fractions.

5. A fraction whose value is equal to one or greater is called an **improper** fraction. $\frac{8}{8}$, $\frac{13}{8}$, $\frac{5}{4}$ ft., $\frac{11}{8}$ pk. are improper fractions.

6. Write 10 proper fractions. Write 5 improper fractions whose value is equal to one, 5 whose value is greater than one.

7. $2\frac{2}{3}$ is called a **mixed** number because it consists of a whole number and a fraction. Write 10 mixed numbers.

8. A whole number is often called an **integer.**

9. A mixed number represents integral units (ones) and fractional units. $3\frac{5}{6}$ represents ones and sixths.

Changing Improper Fractions to Mixed Numbers

1. Name the **unit** in each of the following numbers and tell whether it is integral or fractional.

7 yd., \$8, 7 ninths, $\frac{11}{12}$, $\frac{5}{6}$ ft., \$$\frac{7}{4}$, $2\frac{3}{4}$ ft., $\frac{23}{16}$.

2. Which of the numbers in example one are improper fractions?

3. Is $\frac{4}{3}$ yd. more than 1 yd.? How much?

4. How much is $\frac{4}{4}$ ft.? \$$\frac{3}{3}$? $\frac{8}{8}$?

5. 11 fourths $= 2\frac{3}{4}$. $\frac{8}{3} = 2\frac{2}{3}$. Why is this true?

6. Change $\frac{10}{3}$ to a mixed number.

HINT.—In one there are $\frac{3}{3}$.

SOLUTION.—10 thirds $\div$ 3 thirds $= 3\frac{1}{3}$.

7. Draw a figure to show that $\frac{15}{4}=3\frac{3}{4}$.

8. Study the figure to see if it will help you to change $\frac{9}{2}$, $\frac{17}{8}$, $\frac{16}{3}$, $\frac{23}{6}$ yd., $\$\frac{15}{2}$ to mixed numbers.

9. A boy said $\frac{16}{3}$ ft. was equal to $5\frac{1}{3}$ yd. Was he right or wrong? Why?

10. Another boy said $\frac{35}{16}$ in. $=2\frac{5}{16}$ in. What mistake did he make?

Practice

Change to whole or mixed numbers. Thus $\frac{9}{2}=4\frac{1}{2}$.

	a	b	c	d
1.	$\frac{9}{4}=?$	$\frac{35}{6}=?$	$\frac{21}{4}=?$	$\frac{21}{8}$ in. $=?$
2.	$\frac{9}{3}=?$	$\frac{35}{8}=?$	$\frac{35}{5}=?$	$\frac{35}{3}$ yd. $=?$
3.	$\frac{11}{4}=?$	$\frac{25}{4}=?$	$\frac{25}{3}=?$	$\frac{25}{16}$ ft. $=?$
4.	$\frac{12}{2}=?$	$\frac{12}{3}=?$	$\frac{12}{8}=?$	$\frac{12}{12}$ min. $=?$
5.	$\frac{23}{2}=?$	$\frac{23}{4}=?$	$\frac{23}{5}=?$	$\frac{23}{6}$ mi. $=?$
6.	$\frac{24}{8}=?$	$\frac{72}{9}=?$	$\frac{73}{12}=?$	$\frac{75}{9}$ yd. $=?$
7.	$\frac{55}{6}=?$	$\frac{52}{8}=?$	$\frac{63}{8}=?$	$\frac{70}{12}$ min. $=?$
8.	$\frac{27}{4}=?$	$\frac{35}{16}=?$	$\frac{49}{24}=?$	$\frac{35}{24}$ da. $=?$
9.	$\frac{24}{12}=?$	$\frac{24}{16}=?$	$\frac{22}{10}=?$	$\frac{27}{5}$¢ $=?$
10.	$\frac{37}{8}=?$	$\frac{27}{12}=?$	$\frac{27}{12}=?$	$\frac{27}{8}$ da. $=?$
11.	$\frac{38}{4}=?$	$\frac{29}{8}=?$	$\frac{37}{24}=?$	$\frac{19}{4}$ ft. $=?$

First find by inspection the common measure. Add and change the sum to a mixed number. Solve them without a pencil if you can.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
$\frac{3}{8}$	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{7}{8}$	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{5}{6}$
$\frac{1}{2}$	$\frac{5}{6}$	$\frac{5}{9}$	$\frac{3}{4}$	$\frac{1}{16}$	$\frac{5}{24}$	$\frac{3}{5}$	$\frac{1}{4}$	$\frac{7}{8}$	$\frac{3}{4}$
[illegible]	$\frac{1}{2}$	$\frac{1}{9}$	$\frac{5}{6}$	$\frac{3}{4}$	$\frac{1}{8}$	$\frac{9}{10}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{7}{8}$

Adding Mixed Numbers

1. Find the total length of three remnants of cloth which measured as follows: $3\frac{3}{4}$ yd., $2\frac{5}{6}$ yd., and $4\frac{2}{3}$ yd.

METHOD A	METHOD B
$3\frac{3}{4}=3\frac{9}{12}$	$3\frac{3}{4}$
$2\frac{5}{6}=2\frac{10}{12}$	$2\frac{5}{6}$
$4\frac{2}{3}=4\frac{8}{12}$	$4\frac{2}{3}$
Sum $=9\frac{27}{12}=11\frac{1}{4}$	$9\frac{8+10+9}{12}=9\frac{27}{12}=11\frac{1}{4}$

The total length is $11\frac{1}{4}$ yd.

Find by inspection the common measure of the fractions.

When you use method B, add the integers first. Write the like fractions as shown.

Add the following.

2.	3.	4.	5.	6.	7.
$47\frac{2}{3}$	$62\frac{5}{8}$	$27\frac{1}{3}$	$42\frac{1}{3}$	$15\frac{3}{4}$	$22\frac{1}{24}$
$25\frac{3}{4}$	$48\frac{3}{4}$	$38\frac{5}{6}$	$60\frac{5}{9}$	$18\frac{15}{16}$	$28\frac{2}{3}$
$29\frac{11}{12}$	$72\frac{1}{2}$	$24\frac{1}{2}$	$38\frac{2}{3}$	$19\frac{1}{2}$	$32\frac{1}{8}$

Addends (numbers to be added) are often written in a line instead of in a column. In such case it is convenient to add the integers first, then the fractions.

1. $24\frac{1}{6}+32\frac{7}{8}+19\frac{5}{12}=75+\frac{4+21+10}{24}=75\frac{35}{24}=76\frac{11}{24}$

Study the above solution and then add these examples in the same manner.

2. $34\frac{8}{9}+16\frac{2}{3}+18\frac{7}{9}+64\frac{2}{3}=?$

3. $85\frac{1}{2}+72\frac{3}{4}+64\frac{5}{8}+24\frac{5}{16}=?$

4. $63\frac{2}{3}+27\frac{1}{8}+16\frac{5}{12}+13\frac{17}{24}=?$

5. $96+52\frac{3}{32}+84\frac{5}{8}+36\frac{3}{16}=?$

6. $48\frac{1}{3}+24\frac{1}{6}+13\frac{3}{8}+52\frac{2}{3}=?$

Everyday Problems

1. How much must you add to each of these numbers to make 2 lb.:

$\frac{1}{2}$ lb., $\frac{3}{8}$ lb., $\frac{3}{4}$ lb., $\frac{5}{8}$ lb., $\frac{3}{16}$ lb., $\frac{7}{8}$ lb., $\frac{11}{16}$ lb.?

2. A boy ate $\frac{1}{2}$ of a pie, another ate $\frac{1}{3}$, and a third ate $\frac{3}{4}$. How many whole pies were required to furnish those parts?

3. Three brothers are saving their money for a bicycle. One has enough to pay for $\frac{1}{2}$ of it. Another has enough to pay for $\frac{1}{3}$ of it, and the third has enough to pay for $\frac{1}{6}$ of it. How much more, if any, do they need?

4. The price of wheat per bu. on the market increased on each day for the week as follows: $\frac{1}{8}$¢, $\frac{5}{8}$¢, $\frac{7}{16}$¢, $1\frac{1}{8}$¢, $\frac{3}{4}$¢, $\frac{1}{2}$¢. What was the total increase for the week?

5. What is the distance around an oblong $16\frac{1}{2}$ ft. long and $10\frac{3}{4}$ ft. wide?

6. Marie bought two ribbon remnants, one containing $1\frac{3}{4}$ yards, the other $\frac{5}{8}$ yard. How many yards in both remnants?

7. John weighed $69\frac{3}{4}$ lb. at the end of the school term. When he returned, he said he had gained $5\frac{1}{2}$ lb. during his vacation spent in the country. How much did he then weigh?

8. May sold $2\frac{1}{2}$ doz. eggs Monday, $3\frac{1}{3}$ doz. Wednesday, and $3\frac{1}{2}$ doz. on Saturday evening. How much money did she get for her eggs at 48¢ per dozen?

9. In problem 8, what were the average daily earnings per hen for the week if there were 20 hens?

1. *a.* Can you subtract 3 in. from 8 in.? *b.* 3 in. from 8 ft.?

2. *a.* Can you subtract 1 fourth from 3 fourths? *b.* 1 half from 3 fourths?

3. *a.* How are examples 1 and 2 alike? *b.* How are they different?

4. What did you do in part *b* of examples 1 and 2 before subtracting?

5. In subtraction of integers, numbers must have **like units** (units of the same name) before subtracting. In subtraction of fractions the fractions must also have like units (denominators with the same name) before subtracting.

6. $\frac{7}{8}-\frac{1}{4}=?$ Think, "$\frac{1}{4}=\frac{2}{8}$, $\frac{7}{8}-\frac{2}{8}=\frac{5}{8}$." Write or say the answer, $\frac{5}{8}$.

7. $\frac{5}{6}-\frac{1}{3}=?$ Think, "$\frac{1}{3}=\frac{2}{6}$, $\frac{5}{6}-\frac{2}{6}=\frac{3}{6}$ or $\frac{1}{2}$." Write or say the answer, $\frac{1}{2}$.

Examples

Think as suggested above. Write answers only. Take 20 minutes and no more.

	a	b	c
1.	$\frac{2}{3}-\frac{1}{3}=?$	$\frac{5}{6}-\frac{3}{6}=?$	$\frac{7}{8}-\frac{4}{8}=?$
2.	$\frac{3}{5}-\frac{2}{5}=?$	$\frac{11}{12}-\frac{3}{12}=?$	$\frac{4}{5}-\frac{2}{5}=?$
3.	$\frac{5}{8}-\frac{2}{8}=?$	$\frac{2}{4}-\frac{1}{4}=?$	$\frac{5}{12}-\frac{4}{12}=?$
4.	$\frac{7}{8}-\frac{2}{8}=?$	$\frac{6}{8}-\frac{3}{8}=?$	$\frac{3}{4}-\frac{1}{4}=?$
5.	$\frac{1}{2}-\frac{1}{2}=?$	$\frac{10}{12}-\frac{7}{12}=?$	$\frac{3}{6}-\frac{2}{6}=?$
6.	$\frac{3}{4}-\frac{1}{2}=?$	$\frac{7}{8}-\frac{5}{16}=?$	$\$\frac{3}{4}-\$\frac{1}{2}=?$
7.	$\frac{3}{4}-\frac{7}{12}=?$	$\frac{1}{2}-\frac{1}{3}=?$	$\frac{3}{8}$ yd. $-\frac{1}{4}$ yd. $=?$
8.	$\frac{5}{8}-\frac{3}{8}=?$	$\frac{1}{3}-\frac{1}{6}=?$	$\frac{7}{8}$ mi. $-\frac{3}{4}$ mi. $=?$

9.	$\frac{5}{8} - \frac{1}{4} = ?$	$\frac{3}{8} - \frac{1}{4} = ?$	$\frac{1}{2}$ A. $- \frac{1}{3}$ A. $= ?$
10.	$\frac{1}{5} - \frac{1}{10} = ?$	$\frac{7}{16} - \frac{1}{4} = ?$	$\frac{7}{16}$ ft. $- \frac{1}{4}$ ft. $= ?$
11.	$\frac{1}{3} - \frac{1}{8} = ?$	$\frac{1}{3} - \frac{1}{4} = ?$	$\frac{7}{8}$ da. $- \frac{1}{3}$ da. $= ?$
12.	$\frac{5}{6} - \frac{2}{3} = ?$	$\frac{2}{3} - \frac{5}{9} = ?$	$\frac{11}{12}$ yr. $-$ 2 mo. $= ?$
13.	$\frac{8}{9} - \frac{2}{3} = ?$	$\frac{11}{12} - \frac{3}{4} = ?$	$\frac{1}{3}$ hr. $-$ 10 min. $= ?$
14.	$\frac{23}{24} - \frac{7}{8} = ?$	$\frac{15}{16} - \frac{3}{4} = ?$	80¢ $- \$\frac{3}{4} = ?$
15.	$\frac{3}{5} - \frac{1}{2} = ?$	$\frac{7}{10} - \frac{2}{5} = ?$	$\frac{1}{4}$ bu. $- \frac{3}{4}$ pk. $= ?$

Problems

1. Jane has $\frac{7}{8}$ yd. ribbon. How much will she have left after using $\frac{1}{2}$ yd.?

Write. Amount left $= \frac{7}{8}$ yd. $- \frac{1}{2}$ yd. Think, "$\frac{1}{2} = \frac{4}{8}$. $\frac{7}{8} - \frac{4}{8} = \frac{3}{8}$."
Amount left $= \frac{3}{8}$ yd.

2. May lives $\frac{3}{4}$ of a mile from the schoolhouse, and Kate lives $\frac{2}{3}$ of a mile from it. Which of the two girls lives the greater distance from the schoolhouse, and how much?

3. Which is more, $\frac{3}{4}$ or $\frac{7}{12}$? How much?

4. $\frac{1}{10}$ part of a gold coin is copper and the remaining part is pure gold; what part is pure gold?

5. Thursday morning Harry still has remaining $\frac{3}{4}$ of his week's spending money. During the day he spent $\frac{1}{3}$ of what he had in the morning. What part of his week's allowance had he left on Thursday evening?

6. After traveling two days of a three days' journey a man discovered that he had traveled $\frac{1}{3}$ of the whole journey on the first day and $\frac{1}{4}$ of it on the second day. What part of the journey must he travel in order to complete it on the third day? On which day did he travel slowest? How do you know?

Subtracting Fractions or Mixed Numbers from Whole or Mixed Numbers

I. When the fraction in the subtrahend is smaller than the fraction in the minuend.

1. Fannie had a piece of ribbon $3\frac{1}{2}$ yd. long. After using some of it she found that she had $1\frac{1}{3}$ yd. left. How much had she used?

$$\begin{array}{r} 3\frac{1}{2} \\ \underline{1\frac{1}{3}} \\ 2\frac{1}{6} \end{array}$$

Think, "$\frac{1}{2}=\frac{3}{6}$, $\frac{1}{3}=\frac{2}{6}$, $\frac{2}{6}$ from $\frac{3}{6}=\frac{1}{6}$." Prove (check) the work by adding the remainder to the subtrahend.

She had used $2\frac{1}{6}$ yd.

2. From $9\frac{1}{2}$ take $6\frac{3}{8}$.

Think, "$\frac{3}{8}$ from $\frac{1}{2}$ or $\frac{4}{8}=\frac{1}{8}$."

$$\begin{array}{r} 9\frac{1}{2} \\ \underline{6\frac{3}{8}} \end{array}$$

3. Subtract.

a	b	c	d	e	f	g	h	i
$3\frac{3}{4}$	$7\frac{5}{8}$	$6\frac{1}{2}$	$7\frac{1}{4}$	$9\frac{1}{2}$	$12\frac{7}{8}$	$16\frac{1}{2}$	$15\frac{7}{8}$	$24\frac{5}{6}$
$1\frac{1}{8}$	$2\frac{1}{2}$	$3\frac{1}{4}$	$2\frac{1}{8}$	$\frac{3}{8}$	$8\frac{1}{2}$	$3\frac{1}{4}$	$10\frac{3}{4}$	$13\frac{1}{3}$

II. When the fraction in the subtrahend is larger than the fraction in the minuend.

In a subtraction example if you add one to the minuend and also add one to the subtrahend you will not change the result. In subtracting fractions this is a convenient method when you have a larger fraction in your subtrahend than in your minuend.

1. Mary had a sack of sugar containing $8\frac{1}{4}$ lb. She wished to know how much was left after using $1\frac{3}{4}$ lb. in making cakes for a party.

$8\frac{1}{4}$ Add 1 to $\frac{1}{4}$. Call it $\frac{5}{4}$. Add 1 to 1.
$\underline{1\frac{3}{4}}$ Think, "$\frac{3}{4}$ from $\frac{5}{4}=\frac{2}{4}$ or $\frac{1}{2}$."
$6\frac{1}{2}$ Think, "2 from $8=6$."
Prove this result. She had $6\frac{1}{2}$ lb. left.

2. From $4\frac{1}{2}$ subtract $2\frac{5}{8}$.

$4\frac{1}{2}$ Add 1 to $\frac{1}{2}$. Call it $\frac{3}{2}$. Add 1 to 2.
$\underline{2\frac{5}{8}}$ Think, "$\frac{5}{8}$ from $\frac{3}{2}$ or $\frac{12}{8}=\frac{7}{8}$."
Think, "3 from 4."
Prove the work.

3. Solve these subtraction examples, using the method just explained.

$7\frac{1}{4}$	$9\frac{2}{3}$	$7\frac{1}{8}$	$24\frac{1}{16}$	$25\frac{1}{4}$	$12\frac{1}{3}$	$35\frac{1}{8}$	$18\frac{3}{4}$	$26\frac{1}{8}$
$2\frac{3}{4}$	$6\frac{2}{3}$	$4\frac{1}{2}$	$11\frac{3}{16}$	$10\frac{1}{3}$	$4\frac{5}{9}$	$15\frac{11}{16}$	$6\frac{7}{8}$	$10\frac{5}{8}$

4. Subtract $2\frac{1}{4}$ from 5.

5 Think, "$\frac{1}{4}$ from 1 or $\frac{4}{4}$."
$\underline{2\frac{1}{4}}$ Think, "3 from 5."

5. Subtract each of these fractions from 3.

$\frac{1}{4}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{1}{8}$, $\frac{1}{12}$, $\frac{7}{8}$, $\frac{5}{6}$, $\frac{1}{6}$, $\frac{11}{12}$, $\frac{5}{16}$, $\frac{7}{12}$, $\frac{9}{16}$.

6. Find the answers to these subtraction examples in 5 minutes.

10	12	$8\frac{5}{8}$	$7\frac{5}{12}$	10	$13\frac{1}{2}$	$6\frac{1}{4}$	$8\frac{1}{2}$
$\frac{1}{4}$	$7\frac{1}{4}$	$6\frac{3}{4}$	$3\frac{7}{12}$	$6\frac{1}{2}$	$9\frac{7}{8}$	$2\frac{1}{3}$	$5\frac{1}{6}$
$14\frac{2}{3}$	$10\frac{1}{3}$	$5\frac{1}{12}$	$7\frac{3}{4}$	$16\frac{1}{2}$	$5\frac{1}{2}$	$24\frac{1}{2}$	$11\frac{5}{6}$
$6\frac{1}{4}$	$3\frac{2}{3}$	$\frac{1}{2}$	$\frac{7}{8}$	$5\frac{3}{4}$	$2\frac{1}{4}$	$16\frac{3}{4}$	$2\frac{1}{2}$

In adding or subtracting fractions think them as like fractions and proceed as you do in whole numbers.

Find the sum and then the difference. Prove each answer.

	a	b	c	d	e	f	g
1.	$2\frac{1}{2}$	$8\frac{3}{4}$	$16\frac{2}{3}$	75	$11\frac{4}{5}$	33	$125\frac{1}{8}$
	$1\frac{1}{3}$	$5\frac{1}{2}$	$8\frac{1}{3}$	$33\frac{1}{3}$	$8\frac{3}{10}$	$16\frac{1}{2}$	$108\frac{3}{4}$
2.	$152\frac{5}{6}$	$3\frac{3}{4}$	$5\frac{1}{2}$	24	$13\frac{1}{16}$	23	$192\frac{3}{4}$
	$140\frac{5}{12}$	$2\frac{7}{8}$	$2\frac{3}{4}$	$16\frac{1}{2}$	$8\frac{7}{8}$	$16\frac{1}{8}$	$158\frac{1}{2}$
3.	$572\frac{1}{2}$	$5\frac{11}{12}$	$8\frac{1}{3}$	100	50	100	240
	$268\frac{3}{4}$	$2\frac{1}{2}$	$5\frac{5}{8}$	$37\frac{1}{2}$	$33\frac{1}{3}$	$62\frac{1}{2}$	$187\frac{1}{2}$

Everyday Problems

1. A small basket of tomatoes weighed $9\frac{1}{2}$ lb. The empty basket weighed $\frac{7}{8}$ lb. What was the weight of the tomatoes?

SOLUTION.—Weight of the tomatoes $= 9\frac{1}{2}$ lb. $- \frac{7}{8}$ lb. $= 8\frac{5}{8}$ lb.

2. A boy said he ate $\frac{2}{3}$ of a pie and there was $\frac{1}{2}$ left. How much of a mistake did he make?

3. John's mark in an arithmetic test was $87\frac{1}{2}$, and Frank's was 90. How much better was Frank's mark than John's?

4. A boy erased $2\frac{1}{4}$ ft. from a line $6\frac{1}{8}$ ft. long. How much remained?

5. James rode his wheel $40\frac{1}{2}$ mi. on Monday, $50\frac{3}{4}$ mi. on Tuesday. How far must he ride on Wednesday to reach the 125 mile goal?

6. In a contest John jumped $5\frac{1}{2}$ ft. and Ned jumped $4\frac{3}{4}$ ft. How much farther did John jump than Ned?

7. Ned ran 100 yd. in $12\frac{1}{2}$ seconds. It took Billy $13\frac{1}{4}$ seconds to run that distance. Which made the better time, and how much?

8. After sawing at one time $2\frac{1}{2}$ feet from a board and at another time $6\frac{3}{4}$ feet, a boy found that there were $6\frac{3}{4}$ feet left. What was the length of the board at first?

9. From a 12-foot board 2 pieces each $1\frac{3}{4}$ feet long were cut. How much of the board remained?

10. A telephone pole $20\frac{1}{2}$ feet long was set in the ground $4\frac{3}{4}$ feet deep. How much of the pole was above the ground?

11. From a bolt containing 50 yards of dress goods, pieces were cut as follows: $5\frac{1}{2}$ yards, 7 yards, $8\frac{3}{4}$ yards, and $10\frac{1}{2}$ yards. How many yards were left?

12. One boy weighs $75\frac{1}{4}$ lb. Another weighs $70\frac{1}{2}$ lb. A third one weighs $68\frac{7}{8}$ lb. How much do they all three weigh? How much heavier is the first than the third? How much lighter is the second than the first? What is the difference in weight between the second and the third?

13. In four loads of corn containing the following number of bushels, $28\frac{3}{4}$, $33\frac{1}{2}$, $30\frac{7}{8}$, $29\frac{1}{4}$, how many bushels are there? What is the difference between the largest and the smallest load?

14. A man owns three farms; one of $78\frac{5}{16}$ acres, another of $123\frac{15}{16}$ acres, and another of $183\frac{1}{4}$ acres. How many acres does he own? How much must he add to the smallest farm to make it as large as the largest one?

15. A farmer sowing wheat with a drill sowed $10\frac{1}{2}$ acres on Monday, $12\frac{3}{4}$ acres on Tuesday, $12\frac{1}{4}$ acres on Wednes-

day, $9\frac{1}{4}$ acres on Thursday, $11\frac{1}{8}$ acres on Friday, and $10\frac{3}{4}$ acres on Saturday. How many acres did he sow in the week? What is the difference between the best and the poorest day's work?

16. In 1919 a man had 4 hogs whose total weight was 854 lb. The first one weighed $142\frac{1}{2}$ lb.; the second, $158\frac{3}{4}$ lb.; the third, 250 lb. How did the man find out how heavy the fourth one was without weighing it alone? How much were they all worth at 21¢ a lb.?

17. Three boys ran a relay race. One ran $\frac{1}{2}$ min., another ran $\frac{2}{3}$ min., and the third ran $\frac{3}{4}$ min. How many minutes did it take to run the race?

18. Alice gathered in August, 1919, from her thrift garden tomatoes for 4 successive days as follows: $10\frac{3}{4}$ lb., $12\frac{1}{2}$ lb., $9\frac{5}{8}$ lb., $11\frac{3}{8}$ lb. What were they worth at 8¢ a lb.?

19. John weighs $65\frac{1}{2}$ lb., James $84\frac{3}{4}$ lb., George $76\frac{5}{8}$ lb., and Gilbert $70\frac{1}{4}$ lb. Find their total weight.

20. What is the entire length in feet of these ribbon remnants: $3\frac{1}{2}$ yd., $\frac{3}{4}$ ft., $5\frac{1}{2}$ ft., $1\frac{1}{2}$ yd., $\frac{1}{3}$ ft., $2\frac{11}{12}$ ft.

Practice in Addition and Subtraction

Write answers only.

1. $\frac{1}{2}+\frac{3}{4}-\frac{1}{8}=?$	**5.** $\frac{1}{4}+\frac{3}{8}-\frac{5}{24}=?$
2. $\frac{3}{4}+\frac{3}{8}-\frac{13}{16}=?$	**6.** $\frac{2}{3}-\frac{1}{4}+\frac{1}{2}=?$
3. $16\frac{2}{3}-8\frac{1}{3}+\frac{1}{6}=?$	**7.** $\frac{2}{3}-\frac{2}{9}+\frac{1}{3}=?$
4. $37\frac{1}{2}-12\frac{1}{2}+6=?$	**8.** $37\frac{1}{2}+12\frac{1}{2}-2\frac{1}{2}=?$

Multiplying a Fraction by an Integer

I. Increase the number of fractional units in the multiplicand.

1. If a towel requires $\frac{7}{8}$ yd. of cloth, how much will be required for 3 such towels?

$\frac{7}{8}$ yd. $+\frac{7}{8}$ yd. $+\frac{7}{8}$ yd. $=\frac{21}{8}$ yd.

Instead of solving such problems by addition, you can shorten the work by multiplication just as you did in whole numbers.

$3\times\frac{7}{8}$ yd. $=\frac{21}{8}$ yd.

2. *a.* 2×3 fourths $=$? *b.* 2×2 thirds $=$? *c.* 5×1 sixth $=$?

3. *a.* $2\times\frac{1}{3}=?$ *b.* $5\times\frac{3}{4}=?$ *c.* $7\times\frac{3}{8}=?$ *d.* $5\times\frac{11}{12}=?$ *e.* $5\times\frac{3}{16}=?$

To multiply a fraction by an integer, take the multiplicand as many times as there are ones in the multiplier.

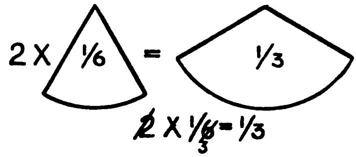
Find the product in each of these examples. Write answers only.

1. $2\times\frac{5}{9}=?$	**8.** $9\times\frac{3}{16}=?$	**15.** $5\times\$\frac{3}{4}=?$
2. $3\times\frac{5}{16}=?$	**9.** $8\times\frac{7}{9}=?$	**16.** $8\times\frac{2}{3}$ yd. $=$?
3. $5\times\frac{2}{3}=?$	**10.** $7\times\frac{2}{3}=?$	**17.** $9\times\frac{3}{4}$ in. $=$?
4. $9\times\frac{5}{8}=?$	**11.** $13\times\frac{3}{4}=?$	**18.** $11\times\$\frac{3}{5}=?$
5. $12\times\frac{3}{5}=?$	**12.** $11\times\frac{2}{3}=?$	**19.** $8\times\$\frac{1}{3}=?$
6. $15\times\frac{3}{8}=?$	**13.** $5\times\frac{3}{4}=?$	**20.** $7\times\$\frac{5}{8}=?$
7. $13\times\frac{3}{8}=?$	**14.** $11\times\frac{5}{12}=?$	**21.** $13\times\$\frac{3}{4}=?$

Write 4 good problems for examples 18 to 21.

II. When the multiplier is a factor of the denominator of the multiplicand, increase the size of the fractional unit.

Here the size of the fractional unit is multiplied by 2. This is shown by omitting the common factor 2 from the multiplier and from the denominator.



1. John gave to one playmate $\frac{1}{4}$ apple and to another one twice as much. How much did he give the other playmate?

$\cancel{2}\times\frac{1}{\cancel{4}}$ apple $=\frac{1}{2}$ apple. In this case we multiplied by 2 by doubling the size of the fractional unit. The multiplication is shown by omitting the common factor 2 from the multiplier and from the denominator.

2. Say the result for each of the following.

(*a*) $\cancel{3}\times\frac{1}{\cancel{6}}=?$ (*b*) $\cancel{4}\times\frac{1}{\cancel{8}}=?$ (*c*) $\cancel{6}\times\frac{1}{\cancel{12}}=?$

(*d*) $\cancel{2}\times\frac{1}{\cancel{2}}=?$ (*e*) $\cancel{8}\times\frac{1}{\cancel{16}}=?$ (*f*) $\cancel{4}\times\frac{1}{\cancel{16}}=?$

3. (*a*) $\cancel{2}\times\frac{5}{\underset{3}{\cancel{6}}}=\frac{5}{3}$. (*b*) $\cancel{2}\times\$\frac{7}{\underset{4}{\cancel{8}}}=\$\frac{7}{4}$. (*c*) $\cancel{2}\times\frac{3}{\underset{2}{\cancel{4}}}$ yd. $=\frac{3}{2}$ yd.

In each of these examples the size of the fractional unit is multiplied by 2. The multiplication is shown by cancellation. The number of fractional units in the product is the same as that in the multiplicand.

4. Name these products.

(*a*) Twelfths $\times 4=?$ (*b*) Sixths $\times 3=?$ (*c*) Fourths $\times 4=?$

5. Write these products.

a	b	c	d	e
$2\times\frac{3}{4}=?$	$6\times\frac{5}{12}=?$	$4\times\frac{7}{12}=?$	$12\times\frac{11}{24}=?$	$8\times\frac{5}{24}=?$

Write the following products. Cancel without pencil.

1. $3\times\frac{7}{6}=?$	**6.** $5\times\frac{3}{10}=?$	**11.** $4\times\$\frac{7}{8}=?$
2. $6\times\frac{5}{24}=?$	**7.** $5\times\frac{4}{5}=?$	**12.** $3\times\frac{7}{12}$ yd. $=?$
3. $6\times\frac{5}{12}=?$	**8.** $6\times\frac{17}{24}=?$	**13.** $8\times\frac{5}{24}$ ft. $=?$
4. $4\times\frac{5}{8}=?$	**9.** $8\times\frac{7}{8}=?$	**14.** $4\times\frac{15}{16}=?$
5. $4\times\frac{1}{12}=?$	**10.** $3\times\frac{5}{9}=?$	**15.** $3\times\frac{2}{3}$ yd. $=?$

III. When the multiplier and the denominator of the multiplicand contain a common factor, increase both the **number** and the **size** of the fractional units in the multiplicand.

$$\text{Example.}—\overset{3}{\cancel{6}}\times\frac{3}{\underset{2}{\cancel{4}}}\text{ ft.}=\frac{9}{2}\text{ ft.}$$

Explanation.—Multiplying by 6 is the same as multiplying by 2, then by 3. When you multiplied by 2, you changed fourths to halves, shown by cancellation. You multiplied by 3 by taking $\frac{3}{2}$ ft. 3 times, giving $\frac{9}{2}$ ft.

Explain the multiplication in the following.

(*a*) $\overset{2}{\cancel{8}}\times\frac{5}{\underset{3}{\cancel{12}}}=\frac{10}{3}$. (*b*) $\overset{3}{\cancel{9}}\times\frac{11}{\underset{8}{\cancel{24}}}=\frac{33}{8}$.

Solve these examples by finding the largest factor common to the multiplier and the denominator and then cancel.

1. $9\times\frac{5}{24}=?$	**6.** $8\times\frac{5}{6}=?$	**11.** $16\times\frac{11}{12}$ ft. $=?$
2. $6\times\frac{9}{2}=?$	**7.** $20\times\frac{7}{8}=?$	**12.** $9\times\frac{2}{3}$ yd. $=?$
3. $4\times\frac{13}{2}=?$	**8.** $24\times\frac{15}{32}=?$	**13.** $12\times\$\frac{5}{8}=?$
4. $12\times\frac{7}{16}=?$	**9.** $18\times\frac{11}{16}=?$	**14.** $6\times\$\frac{3}{4}=?$
5. $15\times\frac{2}{3}=?$	**10.** $12\times\frac{8}{9}=?$	**15.** $10\times\frac{3}{4}$ gal. $=?$

Examine this column for an error.

Continue the table to $20 \times \frac{3}{4}$.

Cancel when you can.

$$1 \times \frac{3}{4} = \frac{3}{4}.$$

$$\cancel{2} \times \frac{3}{\underset{2}{\cancel{4}}} = \frac{3}{2}.$$

$$3 \times \frac{3}{4} = \frac{9}{4}.$$

$$\cancel{4} \times \frac{3}{\cancel{4}} = 3.$$

$$5 \times \frac{3}{4} = \frac{15}{4}.$$

$$\overset{3}{\cancel{6}} \times \frac{3}{\underset{2}{\cancel{4}}} = \frac{9}{2}.$$

$$7 \times \frac{3}{4} = \frac{21}{4}.$$

$$\overset{2}{\cancel{8}} \times \frac{3}{\cancel{4}} = 6.$$

$$9 \times \frac{3}{4} = \frac{27}{4}.$$

$$\overset{5}{\cancel{10}} \times \frac{3}{\underset{2}{\cancel{4}}} = \frac{15}{2}.$$

$$11 \times \frac{3}{4} = \frac{33}{4}.$$

$$\overset{3}{\cancel{12}} \times \frac{3}{\cancel{4}} = 9.$$

Examine this column for errors.

Continue the table to $\$\frac{3}{8} \times 20$.

Cancel when you can.

$$\$\frac{3}{8} \times 1 = \$\frac{3}{8}.$$

$$\$\frac{3}{\underset{4}{\cancel{8}}} \times \cancel{2} = \$\frac{3}{4}.$$

$$\$\frac{3}{8} \times 3 = \$\frac{9}{8}.$$

$$\$\frac{3}{\underset{2}{\cancel{8}}} \times \cancel{4} = \$\frac{3}{2}.$$

$$\$\frac{3}{8} \times 5 = \$\frac{15}{8}.$$

$$\$\frac{3}{\underset{4}{\cancel{8}}} \times \overset{3}{\cancel{6}} = \$\frac{9}{4}.$$

$$\$\frac{3}{8} \times 7 = \$\frac{21}{8}.$$

$$\$\frac{3}{8} \times 8 = \$3.$$

$$\$\frac{3}{8} \times 9 = \$\frac{27}{8}.$$

$$\$\frac{3}{8} \times 10 = \$\frac{30}{8}.$$

$$\$\frac{3}{8} \times 11 = \$\frac{33}{8}.$$

$$\$\frac{3}{\underset{2}{\cancel{8}}} \times \overset{3}{\cancel{12}} = \$\frac{9}{2}.$$

How is the sign $\times$ read in each of the above columns? Why?

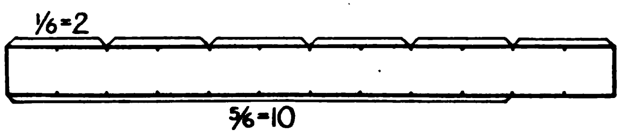
Multiplying an Integer by a Fraction

This is sometimes called finding a fractional part of an integer.

EXAMPLE.—Find $\frac{5}{6} \times 12$.* Read $\frac{5}{6}$ of 12. Why not times 12?

Think, "$\frac{5}{6} \times 12 = 5 \times \frac{1}{6}$ of 12." See figure below.

Write, $\frac{5}{\cancel{6}} \times \overset{2}{\cancel{12}} = 10$. The cancellation shows $\frac{1}{6}$ of 12.



EXAMPLE. Find $\frac{3}{4} \times 11$ ft. What does this mean?

Think, "$\frac{3}{4} \times 11$ ft. $= 3 \times \frac{1}{4}$ of 11 ft. $= 3 \times \frac{11}{4}$ ft. $= \frac{33}{4}$ ft. or $8\frac{1}{4}$ ft." Draw a figure to show this.

Write, $\frac{3}{4} \times 11 = \frac{33}{4}$ or $8\frac{1}{4}$.

Find the following products by the shortest method.

1. $\frac{3}{4} \times 8 = ?$	6. $\frac{3}{4} \times 15 = ?$	11. $\frac{3}{4}$ lb. candy @ 40¢
2. $\frac{5}{6} \times 24 = ?$	7. $\frac{2}{3} \times 20 = ?$	12. $\frac{5}{8}$ lb. sugar @ 16¢
3. $\frac{7}{8} \times 32 = ?$	8. $\frac{3}{5} \times 15 = ?$	13. $\frac{7}{8}$ lb. ham @ 32¢
4. $\frac{5}{12} \times 96 = ?$	9. $\frac{1}{6} \times 29 = ?$	14. $\frac{3}{8}$ lb. tea @ 60¢
5. $\frac{2}{3} \times 7 = ?$	10. $\frac{2}{3} \times 22 = ?$	15. $\frac{3}{4}$ lb. cheese @ 28¢

To multiply an integer by a fraction take that part of the integer which is indicated by the denominator of the multiplier and multiply this result by the numerator of the multiplier.

* NOTE.—If you know the meaning of this expression you can easily solve it because it becomes an example of multiplying a fraction by an integer.

The Multiplier or Multiplicand a Mixed Number

1. Find the cost of 8 lb. of apples @ $6\frac{3}{4}$¢ a lb.

Think, "$8 \times 6\frac{3}{4}$¢ $= 8 \times 6$¢ $+ 8 \times \frac{3}{4}$¢."
Write, $8 \times 6\frac{3}{4} = 54$.
Cost of 8 lb. = 54¢.

2. Find the cost of $2\frac{3}{4}$ lb. candy @ 32¢ per lb.

Think, "$2\frac{3}{4} \times 32$¢ $= 2 \times 32$¢ $+ \frac{3}{4} \times 32$¢."
Write, $2\frac{3}{4} \times 32 = 64 + 24 = 88$.
Cost of $2\frac{3}{4}$ lb. = 88¢.

3. At $150 an acre, find the cost of $84\frac{3}{4}$ acres of land.

Written work.

Think, "$84\frac{3}{4} \times \$150 = \frac{3}{4} \times \$150 + 4 \times \$150 + 80 \times \$150$.

$$
\begin{array}{r}
150 \\
\times 84\frac{3}{4} \\
\hline
37\frac{1}{2} \\
\times 3 \\
\hline
112\frac{1}{2} \\
600 \\
1200 \\
\hline
12712\frac{1}{2}.
\end{array}
$$

The cost of $84\frac{3}{4}$A. = $12712.50.

To multiply a mixed number by an integer or an integer by a mixed number, multiply the fractional and the integral parts separately; then add the products.

Study once more the methods used in solving the problems on this page. Select the one which best fits your problem.

4. A farmer's yield of corn a certain year was 40 bushels an acre. By seed selection and special cultivation he increased his yield the second year $\frac{3}{8}$ of this amount. How many bushels per acre was his yield the second year?

Problems

1. What is the value of a hog weighing 380 pounds at $22\frac{1}{2}$¢ a pound? (July, 1919, price.) What is it worth at today's price?

2. How much can John earn in $9\frac{1}{2}$ days at $2.75 per day?

3. Find the cost of 5 lb. of cane sugar @ $19\frac{1}{2}$¢. (April, 1920, price.)

4. What is the distance around a $5\frac{1}{4}$ inch square?

5. Find the cost of $6\frac{3}{4}$ doz. eggs at 44¢ a doz.

6. A boy's thrift garden is an oblong, 5 rd. long and 3 rd. wide. How many feet of wire netting will be required to fence it?

7. A man offered three boys $1.00 to mow his lawn. The first boy cut $\frac{1}{4}$ of it, the second $\frac{1}{2}$ of it, and the third $\frac{1}{4}$ of it. How much money should each boy receive?

8. In 1918 alfalfa hay sold at $35 per ton. Find the cost of $3\frac{1}{2}$ tons at this rate.

9. A man sold $\frac{3}{8}$ of his 160-acre farm at $132.50 an A. How much money did he get?

10. Find the cost of $16\frac{1}{2}$ bu. of potatoes at $1.32 per bu.

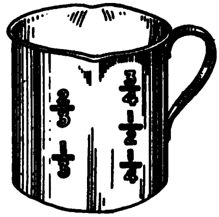
11. What is a $4\frac{1}{2}$-pound fish worth at 32¢ a lb.?

12. What is the cost of $6\frac{1}{2}$ doz. pencils at 40¢ a dozen?

13. In July, 1918, a grocer bought 1000 pounds of sugar at $8\frac{7}{8}$¢ a pound and sold it at $9\frac{1}{2}$¢ a pound. What was his profit?

14. With book closed write the answer.

a. How do you multiply a fraction by an integer? *b.* An integer by a fraction? *c.* A mixed number by an integer?



1. This cup when full holds exactly $\frac{1}{2}$ pt. What part of a pint does it hold when $\frac{1}{2}$ full? when $\frac{1}{4}$ full? when $\frac{1}{3}$ full?

2. When Jennie made corn meal muffins, the recipe which she used asked for $\frac{3}{4}$ cup of milk. She wanted to know what part of a pint that was.

This is the way she thought about it: $\frac{3}{4}$ of $\frac{1}{2}$ pt. is equal to $3\times\frac{1}{4}$ of $\frac{1}{2}$ pt. which is $3\times\frac{1}{8}$ pt. or $\frac{3}{8}$ pt.

3. Another recipe asked for $\frac{2}{3}$ cup of cream. What part of a pint was that?

4. Find $\frac{3}{4}\times\frac{5}{8}$. Read $\frac{3}{4}$ of $\frac{5}{8}$.

MEANING.—Find $3\times\frac{1}{4}$ of $\frac{5}{8}$.

SOLUTION.—$\frac{3}{4}\times\frac{5}{8}=3\times\frac{1}{4}$ of $\frac{5}{8}=3\times\frac{5}{32}=\frac{15}{32}$.

5. $\frac{2}{3}\times\frac{15}{32}=?$ Read $\frac{2}{3}$ of $\frac{15}{32}$.

MEANING.—Find $2\times\frac{1}{3}$ of $\frac{15}{32}$.

SOLUTION.—$\frac{2}{3}\times\frac{15}{32}=2\times\frac{1}{\cancel{3}}$ of $\frac{\overset{5}{\cancel{15}}}{32}=\cancel{2}\times\frac{5}{\underset{16}{\cancel{32}}}=\frac{5}{16}$.

How did you show $\frac{1}{3}$ of $\frac{15}{32}$?

When you multiplied by 2, what did you do to the size of the units in $\frac{5}{32}$? How did you show this?

To multiply one fraction by another

I. Take that part of the multiplicand which is shown by the denominator of the multiplier.

II. Multiply this result by the numerator of the multiplier.

Practice

In each of these examples

1. State the meaning.
2. Solve and shorten the work by cancellation.

1. $\frac{2}{3} \times \frac{3}{4} = ?$	4. $\frac{2}{3} \times \frac{3}{8} = ?$	7. $\frac{2}{3} \times \frac{5}{12}$ ft. $= ?$
2. $\frac{5}{6} \times \frac{24}{32} = ?$	5. $\frac{5}{8} \times \frac{2}{3} = ?$	8. $\frac{5}{6} \times \frac{2}{3}$ yd. $= ?$
3. $\frac{3}{4} \times \frac{5}{6} = ?$	6. $\frac{3}{4} \times \frac{8}{3} = ?$	9. $\frac{3}{2} \times \frac{5}{8} = ?$

Problems

1. $\frac{1}{8}$ of a man's farm of 160 acres was timber. He sold $\frac{3}{4}$ of the timber land. How many acres of timber still on the farm?

2. A man who owned $\frac{5}{6}$ of a farm sold $\frac{2}{3}$ of his share. What part of the farm did he then own?

3. A boy said he had $\frac{1}{3}$ of $\frac{2}{3}$ of a doz. marbles. What might he have said? Why?

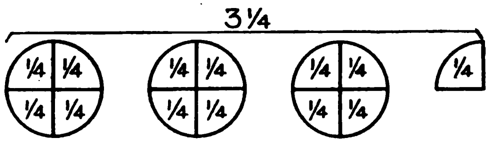
4. A teacher gave to each child in the class $\frac{1}{2}$ of a large sheet of paper. She asked the children to use $\frac{1}{4}$ of their sheet for the spelling words and $\frac{1}{2}$ of it for their problem work. Show by folding what part of the large sheet was used for spelling and what part was used for problems.

5. A girl lost $\frac{1}{4}$ of her money. After giving away $\frac{1}{3}$ of the remainder, what part had she left?

6. If I own a $\frac{1}{2}$ interest in an oil well and sell $\frac{3}{4}$ of my interest to J. A. Wilson, who owns the other half, what part of the well will he then own?

7. If an aviator flies $\frac{3}{4}$ of the distance from St. Louis to Boston in 1 day, what part of the distance does he fly in $\frac{2}{3}$ day?

Changing a Mixed Number to an Improper Fraction



Think, "$1=\frac{4}{4}$. Then $3=3\times\frac{4}{4}=\frac{12}{4}$. And $3\frac{1}{4}=\frac{13}{4}$."

1. Reduce to improper fractions: $3\frac{1}{2}$ in., \$$5\frac{1}{4}$, $2\frac{1}{4}$ sq. in., $4\frac{3}{4}$, $5\frac{1}{3}$.

2. Show your thinking in number 1 by figures such as lines, circles, squares, or oblongs.

3. Supply the missing term.

	a	b	c	d
1.	$5\frac{1}{2}=\frac{}{2}$	$6\frac{1}{4}=\frac{}{4}$	$7\frac{2}{3}=\frac{}{3}$	$8\frac{1}{4}=\frac{}{4}$
2.	$6\frac{2}{3}=\frac{}{3}$	$5\frac{5}{6}=\frac{}{6}$	$8\frac{1}{3}=\frac{}{3}$	$2\frac{1}{12}=\frac{}{12}$
3.	$7\frac{5}{8}=\frac{}{8}$	$3\frac{5}{8}=\frac{}{8}$	$10\frac{5}{8}=\frac{}{8}$	$9\frac{3}{8}=\frac{}{8}$
4.	$5\frac{7}{9}=\frac{}{9}$	$6\frac{5}{12}=\frac{}{12}$	$16\frac{1}{2}=\frac{}{2}$	$12\frac{5}{6}=\frac{}{6}$

Examples

1. Change $187\frac{1}{2}$ to an improper fraction.

SOLUTION.—$187\frac{1}{2}=\frac{187\times 2+1}{2}=\frac{375}{2}$.

Using the method shown in example 1, change these mixed numbers to improper fractions.

	a	b	c	d	e
2.	$66\frac{2}{3}$	$33\frac{1}{3}$	$15\frac{5}{6}$	$30\frac{1}{4}$	$75\frac{3}{4}$
3.	$133\frac{1}{3}$	$87\frac{1}{2}$	$137\frac{1}{2}$	$162\frac{1}{2}$	$287\frac{1}{2}$
4.	$17\frac{5}{12}$	$24\frac{11}{12}$	$8\frac{5}{16}$	$6\frac{5}{32}$	$12\frac{5}{24}$
5.	$19\frac{23}{24}$	$18\frac{11}{16}$	$26\frac{7}{24}$	$365\frac{1}{4}$	$272\frac{1}{4}$

Multiplying a Mixed Number by a Mixed Number

EXAMPLE.—$5\frac{1}{4}\times 3\frac{3}{4}$ ft. = ?

Change the multiplier and multiplicand to improper fractions. The example then has the same meaning as an example in multiplying one fraction by another and should be solved in the same way.

Think, "$\frac{21}{4}\times\frac{15}{4}$ ft. $=21\times\frac{1}{4}$ of $\frac{15}{4}$ ft. $=21\times\frac{15}{16}$ ft."
Write, $\frac{21}{4}\times\frac{15}{4}=\frac{315}{16}$ or $19\frac{11}{16}$.

EXAMPLE.—$3\frac{1}{3}\times 4\frac{1}{2}=?$

Think, "$\frac{10}{3}\times\frac{9}{2}=10\times\frac{1}{3}$ of $\frac{9}{2}=10\times\frac{3}{2}=15$."

Write, $\frac{\overset{5}{\cancel{10}}}{\cancel{3}}\times\frac{\overset{3}{\cancel{9}}}{\cancel{2}}=15.$

To multiply mixed numbers reduce to improper fractions and multiply as in fractions.

Find the products in the shortest way.

1. $3\frac{1}{2}\times 8\frac{2}{3}=?$	4. $7\frac{1}{4}\times 2\frac{1}{2}=?$	7. $5\frac{1}{2}\times 5\frac{1}{2}=?$
2. $6\frac{2}{3}\times 3\frac{3}{5}=?$	5. $6\frac{3}{4}\times 4\frac{4}{9}=?$	8. $16\frac{1}{2}\times 16\frac{1}{2}=?$
3. $7\frac{1}{2}\times 2\frac{1}{10}=?$	6. $3\frac{1}{3}\times 2\frac{5}{12}=?$	9. $3\frac{3}{4}\times 2\frac{2}{5}=?$

Everyday Problems

1. A steamer averaged $18\frac{2}{3}$ miles an hour for $10\frac{1}{2}$ hours. What distance did it travel?

2. A boy mows $5\frac{1}{2}$ acres of meadow in 1 day. At the same rate, how much will he mow in $5\frac{1}{2}$ days?

3. If a family uses $11\frac{2}{3}$ pounds of meat in 1 week, how much will it use in $4\frac{2}{7}$ weeks at the same rate?

4. What is the cost of $5\frac{3}{4}$ pounds of beef at $26\frac{1}{2}$¢ a pound?

5. A boy said $3\frac{1}{2} \times 3\frac{1}{2}$ ft. was 12 ft. How nearly was he correct?

6. Find the area of a square whose side is $5\frac{1}{2}$ yd. Do we have a special name for this figure?

7. Find the area of a square whose side is $16\frac{1}{2}$ ft. Find the difference between the areas of the squares in 6 and 7.

8. Find the cost of $2\frac{1}{2}$ lb. of sugar at $9\frac{1}{2}$¢ a lb. (1918 price). Express the answer to the nearest cent.

9. Find the surface in square inches of 8 window panes, each measuring $21\frac{1}{2}$ inches by $15\frac{1}{2}$ inches.

10. If a man works six days of 10 hours each and $3\frac{3}{4}$ hours overtime, what should he receive for his work at $37\frac{1}{2}$¢ an hour and 50¢ an hour for overtime?

A Multiplication Race

Time yourself. Try again tomorrow. Write answers only.

1.	**2.**	**3.**	**4.**
$1 \times \frac{1}{2} =$	$1 \times 2\frac{1}{2} =$	$1 \times 1\frac{1}{2} =$	$1 \times \frac{3}{4} =$
$2 \times \frac{1}{2} =$	$2 \times 2\frac{1}{2} =$	$2 \times 1\frac{1}{2} =$	$2 \times \frac{3}{4} =$
$3 \times \frac{1}{2} =$	$3 \times 2\frac{1}{2} =$	$3 \times 1\frac{1}{2} =$	$3 \times \frac{3}{4} =$
etc. to	etc. to	etc. to	etc. to
$12 \times \frac{1}{2} =$	$12 \times 2\frac{1}{2} =$	$12 \times 1\frac{1}{2} =$	$12 \times \frac{3}{4} =$

5.	**6.**	**7.**	**8.**
$1 \times 1\frac{1}{4} =$	$1 \times 3\frac{1}{3} =$	$6 \times ? = 15$	$9 \times \frac{2}{3} = ?$
$2 \times 1\frac{1}{4} =$	$2 \times 3\frac{1}{3} =$	$? \times 2\frac{1}{2} = 10$	$? \times \frac{2}{3} = 4$
$3 \times 1\frac{1}{4} =$	$3 \times 3\frac{1}{3} =$	$8 \times ? = 6$	$? \times 9 = 81$
etc. to	etc. to	$10 \times ? = 33\frac{1}{3}$	$7 \times ? = 63$
$12 \times 1\frac{1}{4} =$	$12 \times 3\frac{1}{3} =$	$? \times 1\frac{1}{2} = 12$	$8\frac{1}{2} \times 8 = ?$

Making Purchases at the Grocery Store

C. O. James — **Groceries and Meats**

PAY THE CASHIER

Chicago, Ill., Dec. 22, 1920.

QUANTITY		ARTICLES	PRICE	AMOUNT
$12\frac{1}{2}$	lb.	mackerel	$ .20	$2.50
$7\frac{1}{2}$	lb.	cabbage	$.03\frac{1}{2}$	.26
2	gal.	maple syrup	2.25	4.50
1	sack (24 lb.)	flour		1.65
		Total		$8.91

CASHIER'S TICKET

I bought groceries of C. O. James on Dec. 22, as shown in the cashier's ticket above, and gave a $10.00 bill in payment. How much change did I receive?

Using the name of a grocer in your community, write cashier's tickets for the following purchases at present prices where no price is given.* If the prices given are unreasonable, make such changes as you think are needed.

1. Supply date.

2	lb. coffee	@	?
$2\frac{1}{2}$	lb. butter	@	?
25	lb. sugar	@	?
18	cakes of soap	@	6 for 25¢

I gave in payment $10. How much change did I receive?

* NOTE.—Exchange this work with a classmate for correction before showing it to the teacher.

2. Supply date.

3	cans tomatoes	@ ?
$2\frac{1}{2}$	gal. syrup	@ 65¢
10	lb. lard	@ ?
$2\frac{1}{2}$	lb. raisins	@ 16¢
4	lb. English walnuts	@ 25¢
2	cans baking powder	@ 25¢
$\frac{1}{4}$	lb. ginger	@ 30¢

Gave in payment $10. How much change did I receive?

3. Supply date.

A	$2\frac{1}{2}$-lb. chicken	@ ?
3	pk. potatoes	@ $1.35 a bu.
$3\frac{1}{2}$	doz. eggs	@ ?
10	lb. corn meal	@ $4\frac{1}{2}$¢
$\frac{1}{2}$	doz. candles	@ 45¢
4	lb. white beans	@ $6\frac{1}{4}$¢
9	cans corn	@ 15¢
6	cans tomatoes	@ 14¢

How much change did I receive if a $10 bill was given in payment?

4. Supply date.

7	bars White Rose Soap for 25¢	
$1\frac{1}{2}$	lb. cheese	@ 28¢
2	doz. cans corn	@ ?
1	lb. starch for	?
$1\frac{1}{2}$	bu. potatoes	@ $1.25
50	lb. sugar	@ $9\frac{3}{4}$¢
A	$12\frac{1}{2}$-lb. ham	@ 38¢
$7\frac{1}{2}$	lb. cabbage	@ $4\frac{1}{2}$¢
2	sacks flour	@ $1.35

What is the amount of the purchase?

5. Supply date.

5	frames honey	@ 18¢
3	sacks table salt	@ 5¢
2	lb. coffee	@ 32¢
$\frac{1}{2}$	doz. grapefruit	@ 85¢
2	lb. lard	@ ?
3	lb. fragrant Ceylon tea	@ 75¢
$7\frac{1}{2}$	lb. fancy bacon	@ ?
3	qt. Orleans molasses	@ 16¢

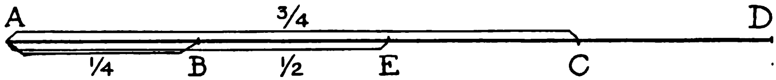
What is the amount of the purchase?

Practice in Supplying the Missing Number

A fifth grade pupil should write the correct answers for all of these examples in less than 10 min.

	1.	2.	3.
(*a*)	$6 \times ? = 15$	$9 \times \frac{2}{3} = ?$	$3 \times ? = 2\frac{1}{4}$
(*b*)	$? \times 2\frac{1}{2} = 10$	$? \times \frac{2}{3} = 4$	$4 \times 1\frac{1}{4} = ?$
(*c*)	$8 \times ? = 6$	$? \times 9 = 81$	$3 \times 2\frac{1}{2} = ?$
(*d*)	$10 \times ? = 33\frac{1}{3}$	$7 \times ? = 63$	$7 \times ? = 1\frac{3}{4}$
(*e*)	$? \times 1\frac{1}{2} = 12$	$8\frac{1}{2} \times 8 = ?$	$? \times \frac{1}{4} = 3$
(*f*)	$12 \times 2\frac{1}{2} = ?$	$6 \times 8\frac{1}{2} = ?$	$15 \times ? = 5$

	4.	5.	6.
(*a*)	$\frac{5}{6} \times 24 = ?$	$\frac{3}{4} \times 0 = ?$	$36 \times \frac{5}{9} = ?$
(*b*)	$9 \times 1\frac{3}{4} = ?$	$9 \times 2\frac{1}{2} = ?$	$24 \times \frac{3}{8} = ?$
(*c*)	$8 \times ? = 20$	$1\frac{3}{4} \times 4 = ?$	$72 \times \frac{8}{9} = ?$
(*d*)	$12 \times 3\frac{1}{2} = ?$	$7 \times 6 = ?$	$32 \times \frac{7}{8} = ?$
(*e*)	$10 \times ? = 25$	$24 \times \frac{7}{8} = ?$	$30 \times ? = 20$
(*f*)	$100 \times ? = 75$	$36 \times ? = 27$	$18 \times ? = 12$
(*g*)	$? \times \frac{1}{2} = 25$	$48 \times ? = 24$	$? \times \frac{5}{6} = 15$



Dividing an Integer or a Fraction by a Fraction

1. Can you divide 8 ft. by 2 ft.? What does it mean?

2. Can you divide 3 fourths by 1 fourth? What does it mean?

3. In the figure, AB is $\frac{1}{4}$ and AC is $\frac{3}{4}$. When you divide $\frac{3}{4}$ by $\frac{1}{4}$ what is done to AC with AB?

4. In examples in which the divisor is a fraction, as in 6 yd. $\div \frac{2}{3}$ yd., the meaning is "How many pieces each $\frac{2}{3}$ yd. long are there in 6 yd.?"

5. $1 \div \frac{1}{4} = ?$ See figure. What is 1 in the figure?

6. (*a*) $\frac{5}{8} \div \frac{1}{8} = ?$ (*b*) $\frac{4}{8} \div \frac{2}{8} = ?$ Draw a figure to show the meaning of examples (*a*) and (*b*).

7. Can you divide 8 ft. by 2 in.? What did you do before dividing? What does 8 ft. $\div$ 2 in. mean?

8. 1 bu. $\div$ 1 pk. = ? 2 rd. $\div$ 2 ft. = ?

9. $\frac{3}{4} \div \frac{1}{2} = ?$ How is this like examples 7 and 8? See figure. AE is $\frac{1}{2}$. What is $\frac{3}{4}$?

10. (*a*) $\frac{7}{8} \div \frac{1}{4} = ?$ (*b*) $\frac{5}{12} \div \frac{1}{6} = ?$ (*c*) $\frac{5}{8} \div \frac{1}{4} = ?$ Draw a figure to show the meaning of examples (*a*) and (*c*).

11. Can you divide \$8 by 2 bu.? Why? Can you divide 2 bu. by 3 pk.? Why?

12. Can you divide \$$\frac{8}{9}$ by $\frac{1}{3}$ bu.? Why? $\frac{8}{9}$ pk. by $\frac{1}{3}$ ft.? Why?

13. How are examples 11 and 12 alike? How are they different?

14. Can you divide \$3 by \$$\frac{1}{4}$? Draw a figure.

15. $3 \div \frac{1}{4} = ?$ $4 \div \frac{1}{3} = ?$ $5 \div \frac{1}{2} = ?$

16. What does $3 \div \frac{3}{4}$ mean? Show it with a figure.

17. Can you divide $\frac{1}{2}$ by $\frac{1}{3}$? Why? How? What does it mean?

18. $\frac{1}{3} \div \frac{1}{4} = ?$ $\frac{2}{3} \div \frac{1}{4} = ?$ $\frac{2}{3} \div \frac{3}{4} = ?$ $\frac{5}{8} \div \frac{1}{3} = ?$

19. When can you divide an integer or a fraction by a fractional divisor? Write your answer.

20. How do you divide an integer or a fraction by a fraction? Write a rule.

21. Why do you need to know how to divide an integer or a fraction by a fraction?

22. Write a problem of your own in which you need to know how to divide by a fraction.

Solve it. Ask your classmates if you have a good problem.

Practice

Write the answer for as many of the following as you can in ten minutes. Try again tomorrow.

	a	b	c
1.	$2 \div \frac{1}{4} = ?$	$3 \div \frac{2}{3} = ?$	$\frac{3}{4} \div \frac{1}{2} = ?$
2.	$\frac{5}{6} \div \frac{1}{3} = ?$	$\frac{7}{9} \div \frac{2}{3} = ?$	$\frac{8}{9} \div \frac{2}{9} = ?$
3.	$\frac{5}{12} \div \frac{1}{6} = ?$	$\frac{3}{4} \div \frac{5}{8} = ?$	$\frac{1}{4} \div \frac{3}{16} = ?$
4.	$\frac{7}{8} \div \frac{1}{16} = ?$	$3 \div \frac{5}{8} = ?$	$5 \div \frac{3}{4} = ?$
5.	$2 \div \frac{5}{12} = ?$	$1 \div \frac{7}{12} = ?$	$\frac{2}{3} \div \frac{3}{4} = ?$
6.	$\frac{3}{8} \div \frac{1}{3} = ?$	$\frac{5}{24} \div \frac{1}{6} = ?$	$\frac{5}{6} \div \frac{2}{3} = ?$
7.	$\frac{7}{8} \div \frac{1}{2} = ?$	$\frac{2}{3} \div \frac{5}{8} = ?$	$\frac{1}{2} \div \frac{1}{12} = ?$
8.	$\frac{7}{8} \div \frac{1}{32} = ?$	$\frac{3}{4} \div \frac{11}{12} = ?$	$\frac{3}{4} \div \frac{2}{3} = ?$
9.	$6 \div \frac{7}{8} = ?$	$3 \div \frac{7}{12} = ?$	$\frac{2}{3} \div \frac{13}{24} = ?$
10.	$\frac{8}{9} \div \frac{2}{3} = ?$	$\frac{7}{8} \div \frac{1}{24} = ?$	$\frac{15}{16} \div \frac{15}{32} = ?$

Using Division

1. Among how many children can you distribute 3 lb. of candy giving each $\frac{3}{8}$ lb.?

2. A boy said that the tomatoes in his basket weighed 6 lb. and that they averaged $\frac{3}{4}$ lb. each. How many did he have?

3. How many $\frac{1}{2}$ bu. baskets in 3 bu. of peaches?

4. How many $\frac{1}{2}$ pints of grape jelly in 2 quarts?

5. How many $\frac{3}{4}$ in. pieces in $3\frac{3}{4}$ inches? Test your result with your ruler.

6. How many $\frac{1}{4}$ inch squares can be cut out of a $2\frac{1}{4}$ inch square? Draw a figure to prove your answer.

7. How many $\frac{1}{4}$ inch squares can be cut out of $2\frac{1}{4}$ square inches? Draw a figure to help you solve the problem.

8. If a piece of ribbon is $\frac{7}{8}$ yd. long, will 10 yd. be enough for a dozen such pieces?

9. At the rate of $\frac{2}{3}$ mi. per min., how long will it require a train to go 30 mi.?

10. Write and solve a good problem about $\frac{1}{6}$ of a pumpkin pie and 2 such pies. What is a **good** problem?

11. How many $\frac{3}{4}$ foot lengths can be cut from 4 yards of wire?

12. How many 4 oz. portions of sugar can be weighed out of a 5 pound sack? Solve this one in two ways.

13. Mary had 1 yard of ribbon out of which she wished to make book marks, each $\frac{1}{2}$ foot long, for Christmas presents. How many could she make?

14. If a towel is $\frac{7}{8}$ yd. long, how many such towels can be cut from a piece of goods $3\frac{1}{2}$ yd. long.

Dividing a Fraction, a Mixed Number, or an Integer by a Mixed Number

1. 5 ft. $\div 2\frac{1}{2}$ ft. = ?

This means how often can you lay off a $2\frac{1}{2}$ ft. line on a 5 ft. line. When you need to divide by a mixed number, follow the method already learned with the fractional divisor; thus, 5 ft. $\div$ $2\frac{1}{2}$ ft. $= \frac{10}{2}$ ft. $\div$ $\frac{5}{2}$ ft. $= 2$.

2. $14 \div 3\frac{1}{2} = ?$

SOLUTION.—$14 \div 3\frac{1}{2} = \frac{28}{2} \div \frac{7}{2} = 4$.

Using the method shown in example 2, solve these examples.

	a	b	c
1.	$15 \div 2\frac{1}{2} = ?$	$20 \div 3\frac{1}{3} = ?$	$22\frac{1}{2} \div 2\frac{1}{2} = ?$
2.	$\$3\frac{1}{2} \div \$1\frac{1}{2} = ?$	$\$25 \div \$6\frac{1}{4} = ?$	$8\frac{1}{2} \div 3\frac{1}{4} = ?$
3.	$2\frac{1}{2} \div 3\frac{1}{3} = ?$	$4\frac{1}{4} \div 2\frac{1}{4} = ?$	$\$12\frac{1}{2} \div \$1\frac{1}{4} = ?$
4.	8 yd. $\div \frac{2}{3}$ yd. = ?	$7\frac{1}{3} \div \frac{2}{3} = ?$	$3\frac{3}{4} \div 3\frac{1}{2} = ?$
5.	$5\frac{5}{6} \div 2\frac{1}{3} = ?$	$\$20 \div \$2\frac{1}{2} = ?$	$2\frac{1}{2} \div 2\frac{1}{3} = ?$

6. Count from 20 to 0 by $2\frac{1}{2}$'s.

7. How many $2\frac{1}{2}$'s in 30? How many in 40? How many in 60?

Practical Problems

1. Two girls found that they could make $3\frac{1}{2}$ quarts of lemonade for 25¢. Find the profit on 7 quarts if they sold it at 10¢ per pint glass.

2. How many pans are required to bake 2 doz. biscuits if one pan holds $\frac{2}{3}$ doz.?

3. At an average rate of $3\frac{1}{2}$ mi. per hr., how long will it take a boy to walk $10\frac{1}{2}$ mi.?

1. In each of these examples state first the **meaning** and then the **result.**

(*a*) $\$2\overline{)\$4}$ (*b*) $2\overline{)4 \text{ ft.}}$ (*c*) $2\overline{)2 \text{ thirds}}$ (*d*) $3\overline{)3 \text{ fourths}}$
(*e*) $\$4 \div \$2 = ?$ (*f*) $8 \text{ in.} \div 2 = ?$ (*g*) $\frac{2}{3} \div 2 = ?$ (*h*) $\frac{3}{4} \div 3 = ?$

2. $\frac{3}{4}$ of a pie was divided equally among 3 girls. What part of a pie did each receive?

3. Two boys shared equally $\frac{2}{3}$ of a melon. What part did each receive?

4. $\frac{3}{4}$ lb. of sugar was used in baking 3 cakes. How much was that for each cake?

5. In each of these examples state first the **meaning** and then the **result.** (*a*) $\frac{3}{6} \div 3 = ?$ (*b*) $\frac{5}{8} \div 5 = ?$ (*c*) $\frac{15}{32} \div 3 = ?$ (*d*) $\frac{15}{16} \div 3 = ?$ (*e*) $\frac{4}{5} \div 4 = ?$

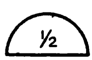
6. What was done with the number of fractional units (the numerator) in each of the examples in number 5?

Certain fractions may be divided by an integer by dividing the number of fractional units (numerator) by the divisor.

7. State the quotient for each of these division examples.

(*a*) $\frac{7}{8} \div 7 = ?$ (*b*) $\frac{5}{12} \div 5 = ?$ (*c*) $\frac{8}{12} \div 4 = ?$
(*d*) $\frac{9}{12} \div 3 = ?$ (*e*) $\frac{6}{8} \div 6 = ?$ (*f*) $\frac{12}{16} \div 12 = ?$

8. Can you use the method in number 7 in dividing $\frac{1}{2}$ watermelon by 2? What does $\frac{1}{2} \div 2$ mean?

9. 

÷ 2 = 

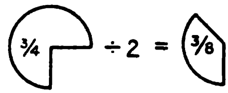
$\frac{1}{2} \div 2 = \frac{1}{4}$.

10. With the help of a figure, find these quotients: $\frac{1}{3} \div 2$, $\frac{1}{4} \div 2$, $\frac{1}{2} \div 3$, $\frac{1}{2} \div 4$.

11. Take a sheet of paper and divide it into 4 equal parts. How large is each of these parts? Divide one of

these parts into 3 equal parts. How large is one of these small parts?

12. $\frac{3}{4} \div 2 = \frac{3}{8}$.



13. With the help of a figure, find these quotients: $\frac{2}{3} \div 3$, $\frac{5}{8} \div 2$, $\frac{3}{8} \div 2$.

14. What was done with the size of the fractional unit in each of the examples in number 10, 11, 13 and 14?

Fractions may be divided by an integer by dividing the size of the fractional unit.

HINT.—This is easily done by multiplying the denominator by the divisor.

15. What does each of the following mean: $\frac{3}{4}$ pie $\div 2$? $\frac{5}{8}$ in. $\div 4$? $\frac{2}{3}$ yd. $\div 3$? $\frac{7}{8}$ lb. $\div 2$? State the result for each of these divisions.

A fraction is divided by an integer

I. By dividing the number of fractional units.

II. By dividing the size of the fractional units.

16. Using the easiest and shortest way, divide each of these examples by 2, by 3, by 4.

(*a*) $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{5}$, $\frac{8}{9}$, $\frac{4}{5}$, $\frac{14}{3}$, $\frac{5}{12}$, $\frac{15}{8}$, $\frac{5}{6}$, $\frac{11}{12}$, $\frac{7}{8}$, $\frac{18}{12}$.
(*b*) $\$\frac{3}{4}$, $\frac{8}{12}$ yd., $\frac{7}{8}$ in., $\frac{1}{3}$ yd., $\frac{1}{2}$ pt., $\frac{1}{3}$ qt., $\$\frac{3}{2}$, $\frac{3}{4}$ gal., $\$\frac{1}{5}$.
(*c*) $\frac{1}{2}$ yd., $\$\frac{3}{8}$, $\frac{5}{8}$ in., $\frac{3}{4}$ qt., $\frac{18}{12}$ ft., $\$\frac{4}{5}$, $\frac{7}{8}$ lb., $\frac{1}{2}$ bu., $\$\frac{7}{8}$.

17. (*a*) $\frac{5}{8}$ yd. $\div 5 = ?$ (*b*) $\frac{5}{8}$ yd. $\div 3 = ?$ (*c*) $\frac{3}{4}$ in. $\div 4 = ?$
(*d*) $\frac{1}{2}$ in. $\div 4 = ?$ (*e*) $\frac{3}{4}$ ton $\div 8 = ?$ (*f*) $\frac{5}{6}$ mi. $\div 5 = ?$

Examples for Practice

How many of these can you do right in 10 min.? Try again tomorrow.

	a	b	c
1.	$\frac{3}{4} \div 8 = ?$	$\frac{5}{8} \div 4 = ?$	$\frac{5}{9} \div 5 = ?$
2.	$\frac{3}{8} \div 3 = ?$	$\frac{1}{8} \div 3 = ?$	$\frac{11}{12} \div 2 = ?$
3.	$\frac{1}{2} \div 12 = ?$	$\frac{1}{3} \div 8 = ?$	$\frac{2}{3} \div 3 = ?$
4.	$\frac{2}{5} \div 2 = ?$	$\frac{7}{8} \div 7 = ?$	$\frac{7}{12} \div 7 = ?$
5.	$\frac{15}{16}$ in. $\div 3 = ?$	$\frac{3}{4}$ yd. $\div 4 = ?$	$\frac{2}{3}$ qt. $\div 2 = ?$
6.	$\$\frac{4}{5} \div 4 = ?$	$\frac{8}{12}$ yd. $\div 8 = ?$	$\$\frac{2}{3} \div 8 = ?$
7.	$\frac{1}{12}$ in. $\div 2 = ?$	$\frac{11}{12}$ in. $\div 2 = ?$	$\frac{5}{6}$ ft. $\div 4 = ?$

Problems

1. If one child receives one piece, what part of a watermelon does each get when $\frac{1}{2}$ of a melon is divided into 2 equal parts? into 3 equal parts? into 4 equal parts?

2. How many children in each of the groups in problem 1? If you like to eat watermelon, in which group would you rather be? Why?

3. A grocer buys oranges at 20¢ a doz. and sells them at 3¢ each. What fraction of a dollar does he gain on each doz.? How many doz. must he sell to gain $4?

4. If $\frac{3}{4}$ of an acre is divided into 6 equal city lots, what part of an acre does each lot contain?

5. Draw the figure if the land in problem 4 before division is an oblong 270 feet long. There are 43,560 sq. ft. in 1 acre.

6. Find the width of each lot in problem 4 if the width of all the lots is the length of the original tract. Draw one lot.

Dividing a Mixed Number by a Small Integer

I. When the dividend is small, change it to an improper fraction and proceed as in dividing a fraction by an integer.

EXAMPLE.—Divide $1\frac{2}{3}$ by 4.

SOLUTION.—$\frac{5}{3} \div 4 = \frac{5}{12}$.

II. When the dividend is large, divide by short division as in integers.

EXAMPLE.—Divide $385\frac{1}{3}$ by 4.

$$4\overline{)385\frac{1}{3}}\quad = 96\frac{1}{3}$$

$\frac{1}{4}$ of 38 is 9 and 2 over.
$\frac{1}{4}$ of $25\frac{1}{3}$ is 6 and $1\frac{1}{3}$ over.*
$\frac{1}{4}$ of $1\frac{1}{3}$ is $\frac{1}{4}$ of $\frac{4}{3}$ which is $\frac{1}{3}$.

* Dividing the last remainder becomes an example belonging to type I.

Examples

Using the shortest method find the quotients in these examples.

	a	b	c
1.	$8\frac{1}{3} \div 5 = ?$	$2\frac{2}{3} \div 8 = ?$	$9\frac{1}{3} \div 8 = ?$
2.	$6\frac{3}{4} \div 4 = ?$	$7\frac{1}{2} \div 12 = ?$	$842\frac{1}{2} \div 3 = ?$
3.	$942\frac{1}{3} \div 4 = ?$	$856\frac{1}{2} \div 8 = ?$	$374\frac{1}{8} \div 4 = ?$
4.	$341\frac{2}{3} \div 3 = ?$	$148\frac{2}{3} \div 6 = ?$	$352\frac{1}{12} \div 2 = ?$
5.	$896\frac{7}{8} \div 3 = ?$	$324\frac{1}{2} \div 8 = ?$	$368\frac{1}{4} \div 6 = ?$

Problem

An Iowa pig-club boy fed 4 pigs which weighed exactly $865\frac{3}{4}$ lb. at 7 months of age. What was their average weight?

In computing with abstract numbers (numbers without a name) it is sometimes more convenient to invert the divisor and proceed as in multiplication of fractions.

EXAMPLE.—$\frac{3}{4} \div \frac{1}{9} = \frac{3}{4} \times \frac{9}{1} = \frac{27}{4}$ or $6\frac{3}{4}$.

EXAMPLE.—$\frac{3}{4} \div 16 = \frac{3}{4} \times \frac{1}{16} = \frac{3}{64}$.

Solve these examples by inverting the divisor and multiplying.

	a	b	c	d
1.	$\frac{5}{6} \div 9 = ?$	$3 \div 4\frac{1}{2} = ?$	$5 \div 6 = ?$	$3\frac{1}{2} \div 7 = ?$
2.	$5\frac{1}{2} \div 6\frac{2}{3} = ?$	$2 \div 15 = ?$	$\frac{2}{3} \div 8 = ?$	$\frac{5}{9} \div \frac{1}{2} = ?$
3.	$\frac{1}{4} \div \frac{1}{3} = ?$	$\frac{8}{5} \div \frac{5}{3} = ?$	$6\frac{1}{4} \div 2\frac{1}{2} = ?$	$6\frac{1}{2} \div 7 = ?$
4.	$8 \div \frac{1}{2} = ?$	$9 \div 3\frac{1}{2} = ?$	$17 \div \frac{3}{4} = ?$	$2\frac{1}{3} \div 3\frac{1}{4} = ?$

Mixed Problems

1. Jane cut $10\frac{2}{3}$ yd. of muslin into 4 equal lengths. How long was each piece?

2. A young man picked $2\frac{1}{2}$ bushels of cherries in 5 hours. What part of a bushel did he average per hour?

3. I bought 3 grape fruit weighing $2\frac{1}{4}$ lb. for 25¢. What was their average weight?

4. A slow workman can husk an acre of corn in $1\frac{1}{4}$ days. How large a field can he husk in a week of 6 days?

5. If it takes $\frac{3}{4}$ bushel of clover seed to sow 6 acres, what part of a bushel does it take to sow one acre?

6. If a boy can cut $2\frac{1}{4}$ cords of wood in 3 days, what part of a cord can be cut in one day? How many cu. ft. are cut in a day at this rate? There are 128 cu. ft. in a cord.

7. If a laborer receives $3 for a job requiring $1\frac{3}{4}$ days' work, how much should he receive for $3\frac{1}{2}$ days' work?

HINT.—Compare $3\frac{1}{2}$ days with $1\frac{3}{4}$ days.

A Fraction Race

A good 5th grade pupil should have 80 right in 30 minutes. Can you do better on the first run?

Read across the page, write answers only.

There are 115 examples in this exercise.

Work 30 minutes and no more.

	a	b	c	d	e
1.	$\frac{1}{2}+\frac{1}{4}$	$\frac{1}{4}+\frac{1}{8}$	$\frac{1}{3}+\frac{1}{6}$	$\frac{1}{5}+\frac{1}{10}$	$\frac{1}{3}+\frac{1}{4}$
2.	$\frac{3}{4}+\frac{1}{8}$	$\frac{2}{3}+\frac{1}{6}$	$\frac{2}{5}+\frac{1}{10}$	$\frac{2}{3}+\frac{1}{9}$	$\frac{1}{3}+\frac{2}{9}$
3.	$\frac{1}{2}-\frac{1}{4}$	$\frac{1}{4}-\frac{1}{8}$	$\frac{3}{4}-\frac{5}{8}$	$\frac{1}{5}-\frac{1}{10}$	$\frac{2}{5}-\frac{3}{10}$
4.	$\frac{1}{3}-\frac{1}{6}$	$\frac{1}{3}-\frac{1}{9}$	$\frac{2}{3}-\frac{1}{6}$	$\frac{2}{3}-\frac{4}{9}$	$\frac{2}{3}-\frac{1}{2}$
5.	$\frac{1}{2}\times 3$	$\frac{1}{3}\times 4$	$\frac{1}{4}\times 6$	$\frac{1}{5}\times 6$	$\frac{1}{6}\times 4$
6.	$\frac{2}{3}\times 4$	$\frac{3}{4}\times 4$	$\frac{5}{6}\times 4$	$\frac{2}{5}\times 4$	$\frac{3}{5}\times 5$
7.	$\frac{3}{5}\div 3$	$\frac{6}{12}\div 2$	$\frac{8}{9}\div 4$	$\frac{12}{16}\div 3$	$\frac{18}{25}\div 6$
8.	$\frac{1}{2}\div\frac{1}{2}$	$\frac{1}{2}\div\frac{1}{3}$	$\frac{1}{3}\div\frac{1}{2}$	$\frac{2}{3}\div\frac{3}{4}$	$\frac{3}{4}\div\frac{2}{3}$
9.	$\frac{2}{3}\div 2$	$\frac{1}{3}\div 2$	$\frac{3}{5}\div 4$	$\frac{5}{3}\div 3$	$\frac{3}{4}\div 5$
10.	$\frac{2}{5}+\frac{3}{10}$	$\frac{7}{10}+\frac{2}{5}$	$\frac{7}{10}\times 5$	$\frac{18}{9}\div 9$	$\frac{5}{8}\times\frac{1}{2}$
11.	$\frac{1}{2}-\frac{3}{8}$	$\frac{4}{5}\times 4$	$\frac{21}{2}\div 3$	$\frac{1}{4}+\frac{1}{3}$	$\frac{1}{3}-\frac{1}{4}$
12.	$2\frac{1}{5}\times 4$	$15\frac{5}{8}\div 5$	$\frac{1}{2}+2\frac{1}{4}$	$1\frac{1}{2}-\frac{3}{4}$	$\frac{2}{3}\times\frac{9}{16}$

	a	b	c	d	e
13.	$3\frac{3}{4} \div 3$	$8\frac{4}{7} \div 4$	$10\frac{5}{8} \div 5$	$12\frac{8}{9} \div 4$	$18\frac{2}{3} \div 6$
14.	$\frac{21}{4} \div 7$	$\frac{6}{7} \div 6$	$\frac{12}{16} \div 4$	$\frac{24}{25} \div 8$	$\frac{27}{28} \div 9$
15.	$\frac{3}{5} - \frac{1}{10}$	$2\frac{1}{2} - 1\frac{1}{4}$	$3\frac{1}{3} + 2\frac{1}{6}$	$\frac{4}{9} \times \frac{6}{12}$	$\frac{1}{10} \div \frac{3}{5}$
16.	$\frac{1}{8} + \frac{1}{2}$	$\frac{1}{6} + \frac{1}{2}$	$\frac{1}{10} + \frac{1}{2}$	$\frac{5}{6} + \frac{2}{3}$	$\frac{3}{8} + \frac{1}{2}$
17.	$\frac{5}{6} - \frac{1}{3}$	$\frac{5}{8} - \frac{1}{3}$	$\frac{5}{6} - \frac{2}{3}$	$\frac{7}{9} - \frac{2}{3}$	$\frac{5}{6} - \frac{1}{2}$
18.	$\frac{4}{5} \times 3$	$\frac{2}{5} \times 6$	$\frac{1}{7} \times 9$	$\frac{2}{7} \times 5$	$\frac{3}{7} \times 3$
19.	$\frac{1}{2} \times \frac{2}{3}$	$\frac{3}{4} \times \frac{2}{3}$	$\frac{5}{8} \times \frac{2}{5}$	$\frac{3}{8} \times \frac{4}{9}$	$\frac{3}{4} \times \frac{5}{12}$
20.	$\frac{1}{2} - \frac{3}{10}$	$\frac{1}{2} + \frac{3}{4}$	$\frac{1}{2} \div \frac{5}{6}$	$\frac{1}{2} + \frac{5}{8}$	$\frac{1}{2} + \frac{7}{10}$
21.	$\frac{3}{4} + \frac{1}{6}$	$\frac{7}{8} - \frac{3}{4}$	$8 \times \frac{3}{16}$	$\frac{8}{9} \times 3$	$5 \div 2\frac{1}{2}$
22.	$2\frac{1}{2} \times 8$	$\frac{3}{4} + \frac{5}{16}$	$\frac{9}{10} \div \frac{2}{5}$	$\frac{3}{4} \div 4$	$7 \div 1\frac{1}{2}$
23.	$6 - 1\frac{1}{2}$	$\frac{5}{8} - \frac{13}{24}$	$\frac{5}{6} + 1\frac{3}{4}$	$2\frac{1}{2} + 2\frac{3}{4}$	$2 \times 5\frac{3}{4}$

NOTE.—If you did not run well, get ready for another race in a week from today.

A Fraction Problem Test

1. Pepper is sold in boxes holding $\frac{1}{8}$ lb. each. How much in 4 boxes?

2. James lives $\frac{3}{8}$ mi. from school. If he walks this distance 4 times each school day, how far does he walk in a school month?

3. If a laboring man eats $\frac{3}{8}$ lb. meat per day, how much meat does he eat in 4 weeks?

4. If an acre produces $\frac{5}{8}$ bale of cotton and a farmer owns 30 such acres, how much is his cotton crop worth at 30¢ a lb.? (The price in 1918.) Count 500 lb. to a bale.

5. In August, 1918, each person was allowed about $\frac{1}{16}$ lb. of sugar daily. At this rate what was the sugar bill for August in a family of four, if sugar cost 9¢ per lb.?

6. At the rate of $\frac{1}{24}$ mi. per minute, how far can a boy walk in one hour?

7. A certain kind of candy is cut in small blocks weighing $\frac{3}{4}$ oz. each. How many ounces of candy will be required to give one such piece to each of 40 children?

8. Three Jonathan apple trees bore fruit in 1920 as follows: $10\frac{1}{2}$ bu., $12\frac{3}{4}$ bu., $8\frac{1}{2}$ bu. What was the average yield per tree?

9. A man divided his farm of $203\frac{5}{8}$ acres equally among his three sons. What was each one's share?

10. Write and solve a **good** problem about ribbon in which the numbers are $2\frac{1}{2}$ yd. and $\frac{3}{4}$ yd. What does it take to make a good problem?

11. At $26\frac{1}{2}$¢ a gallon how many gallons of gasoline can I buy for $1.25? How much change should I get?

12. A boy did 5 addition examples in $2\frac{1}{2}$ minutes. At this rate how many should he solve in 10 minutes?

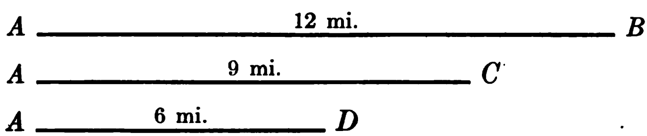
HINT.—How many $2\frac{1}{2}$'s in 10?

13. How many yards of cloth at $33\frac{1}{3}$¢ a yard can be bought for $2.

CHAPTER IV

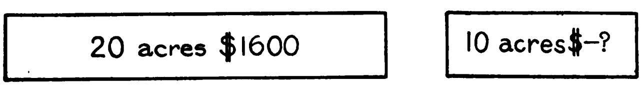
USING FRACTIONS

Finding what Part One Number Is of Another



1. A boy scout walked a 12 mile trip. What part of his trip had he made when he had gone 6 mi.? Compare 6 mi. with 12 mi. What part when he had gone 3 mi.? 4 mi.? 8 mi.? 9 mi.? Which of these parts are shown in the figure?

2. A farmer has a 20 acre field worth $1600 and a 10 acre field whose land is as good as that in the 20 acre field. Compare the area of the small field with that of the large field. What is the value of the 10 acre field? See figures below.



3. Mary had 4 yd. of ribbon. She needed 3 yd. of it for Christmas book marks. What part of her ribbon did she use for book marks? Draw figures to show your result.

When you find what part one number is of another, you compare (measure) the small number with the large number. This is just another way of saying you divide the small number by the large number.

4. What is the divisor in problem 1 on the previous page? What are the dividends?

5. What is the divisor in problem 2? What is the dividend?

6. What part is 9 in. of 12 in.?

HINT.—In finding fractional parts always express your answer in largest units (lowest terms).

7. What part of 8 is 3? What part of 24 is 16?

HINT.—Think $3 \div 8 =$ ____.

8. What part of 2 ft. is 8 in.?

HINT.—What must you do before you can compare two numbers with different names (unlike numbers)?

9. Roy solved $\frac{3}{4}$ of the problems in the lesson, and Mack solved $\frac{2}{3}$ of them. Compare the number Mack solved with the number Roy solved.

HINT.—Compare $\frac{2}{3}$ with $\frac{3}{4}$. What must you do before you can compare two unlike fractions?

Examples

Solve all you can without a pencil.

1. What part is 6 in. of 9 in.?

2. What part of 8 ft. is 6 ft.?

3. What part of a yd. is 15 in.?

4. What part of a ton is 800 lb.?

5. 2 qt. is what part of 2 gal.?

6. 180 rd. is what part of a mile?
7. What part of an acre is 120 sq. rd.?
8. What part of $\frac{1}{2}$ ft. is $\frac{1}{4}$ ft.?
9. $\$\frac{3}{8}$ is what part of $\$\frac{3}{4}$?
10. $\frac{5}{9}$ yd. is what part of $\frac{2}{3}$ yd.?
11. $\frac{7}{16}$ ft. is what part of $\frac{7}{8}$ ft.?
12. $\frac{7}{8}$ ft. is what part of 4 ft.?
13. 2 in. is what part of 5 ft. 4 in.?
14. 1 lb. 2 oz. is what part of 1 lb. 8 oz.?
15. 120 rd. is what part of 320 rd.?
16. $6\frac{1}{4}$¢ is what part of 25¢?
17. $12\frac{1}{2}$¢ is what part of \$1?
18. $66\frac{2}{3}$ is what part of 200?
19. What part of 500 is 125?
20. What part of 100 is 75?

Comparison Problems

1. If $\frac{1}{2}$ lb. of candy costs 20¢, how much will $\frac{1}{4}$ lb. cost?
2. If 4 oranges are worth 20¢, find cost of 3 at same rate.

HINT.—Compare the cost of 3 with the cost of 4. Do not find the cost of 1 in any problem unless it is asked for.

3. If a boy walks 3 mi. in $\frac{3}{4}$ hr., how far does he walk in $\frac{1}{2}$ hr.?

HINT.—Compare $\frac{1}{2}$ hour with $\frac{3}{4}$ hour.

4. Find the cost of 120 sq. rd. of land when an acre is worth \$200.
5. If $\frac{3}{4}$ yard of cloth cost 30¢, what will $\frac{5}{8}$ yard cost?
6. If $\frac{5}{8}$ of an acre of land is worth \$60, what is $\frac{3}{4}$ of an acre worth?

7. If 14 acres of wheat yield 350 bu., find the yield of 7 acres.

8. Find the cost of 8 eggs at 57¢ a dozen.

9. If a quart of milk costs 18¢, how much should I get for 9¢?

10. A girl bought $\frac{2}{3}$ yd. of ribbon for 24¢. She had 16¢ left in change. How much more of the same ribbon can she buy?

11. A boy had 40 bu. of potatoes from a $\frac{1}{3}$ acre patch. At this rate what would $\frac{1}{4}$ acre patch produce?

12. Marbles are 25 for a dime. A boy has only 4 pennies. How many marbles can he buy?

13. At 40¢ a dozen, how many can I get for 30¢?

14. I walked 16 miles of a 22-mile journey in a day of 8 hours. What part of the next day will it take to complete the journey if I walk at the same rate?

15. If $\frac{3}{4}$ of a farm is worth $6000, what is $\frac{3}{8}$ of it worth?

16. John is saving for a $35-bicycle. When he had $20, he spent $\frac{1}{2}$ of his money for clothes. Later he needed shoes and spent $\frac{1}{2}$ of what he had left. He has now left what part of what he had saved?

17. When candy is selling at 30¢ a lb., how much do I get for 5¢? for 10¢? for 15¢? for 25¢?

HINT.—Give your answer to the nearest $\frac{1}{2}$ ounce below the exact weight. The answer for 25¢ is 13 ounces, which is the nearest $\frac{1}{2}$ ounce below $\frac{5}{6}$ lb., or $13\frac{1}{3}$ ounces.

18. How much 40¢ coffee should I get for 10¢? for 15¢? for 20¢? for 25¢? for 30¢?

19. A boy scout can walk 4 miles the first hour. How far is that in 20 minutes?

How to Use the Remainder

In division you should sometimes express the remainder as part of the quotient and sometimes you should not do so.

In the problem, "To how many boys can I give \$17, giving to each \$3", the answer would be wrong if you divided the remainder. The answer is 5 boys and \$2 remaining.

In the problem, "How many yards of silk at \$3 per yard can I buy for \$17" the remainder, \$2, should be divided by \$3, meaning that for \$2 I can buy $\frac{2}{3}$ yd. The answer clearly is $5\frac{2}{3}$ yd.

In the problem, "A boy had 15c with which to buy candy at 2¢ a stick. How many whole sticks could he buy?", the answer is 7 sticks and 1¢ remaining. But in the problem, "Cut 16 in. of ribbon into 3 equal parts. What is the size of each part?", the proper answer is $5\frac{1}{3}$ in.

In the following problems state the answer, dividing the remainder if it is proper to do so.

1. Divide 17 qt. of nuts equally among 4 boys.

2. Among how many boys can I divide 21 qt. of chestnuts giving each 4 qt.?

3. At \$100 an acre how many acres of land can I buy for \$2150?

4. A 25 lb. bucket of candy was to be put into $\frac{3}{4}$ lb. boxes for a children's party. How many boxes were required?

5. What is $\frac{1}{5}$ of 26?

6. Divide $47 equally among 5 men.

7. Find one of the 3 equal parts of 7 yd.

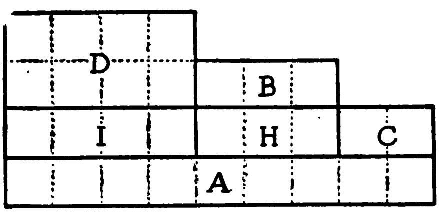
8. A man had $276 with which to buy young cattle at $24 each. How many could he buy?

9. How many oranges at 4¢ each can one buy for 25¢?

10. 32 parent purple martins were observed to make 3277 visits to their young in one day. What was the average number of visits that each bird made?

11. When do you not express the remainder as part of the quotient? Write your answer.

Finding Ratios



1. How many times does A contain C? How many times does I contain C? Compare D with C.

2. How many times does H contain B? How often does A contain B?

3. How often can you take I out of D? How often out of A? Compare D with B.

4. What part of H is C? Of I? Of D? Compare C with H.

5. What part of A is H? What part of I is H?

6. I is what part of D? What part of A? Compare B with D.

7. The answers to the above questions are **ratios**. Write these answers once more. Compare those in 1, 2, 3 with those in 4, 5, 6.

8. **A ratio is a number which shows how many times one number contains another or what part one number is of another.**

9. When you find the ratio of two numbers you always compare one number (the dividend) with another (the divisor). The ratio of 6 to 2 is 3. The ratio of 2 in. to 4 in. is $\frac{1}{2}$.

10. Finding a ratio is using which kind of division?

11. The sign for indicating a ratio is (:) which may be considered the common sign for division ($\div$) with the horizontal line omitted.

12. The expression 8 : 2 is read, "The ratio of 8 to 2."

13. Read the following expressions.

(*a*) 4 in. : 3 in. = ? (*b*) 16 : 24 = ? (*c*) 9 : 12 = ?
(*d*) 8 oz. : 1 lb. = ? (*e*) $9 : 50¢ = ? (*f*) 24 : 15 = ?

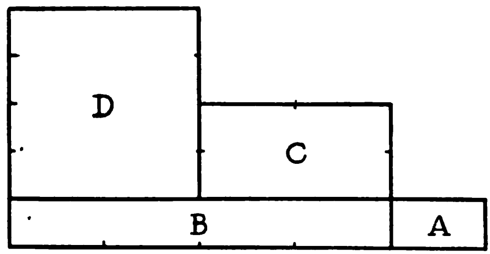
Practice in Finding Ratios

State the ratios expressed in largest units (lowest terms).

1. 4 to 2; 2 to 4.
2. 5 to 10; 10 to 5.
3. 6 in. to 3 in.; 3 in. to 6 in.
4. 8 ft. to 10 ft.; 10 ft. to 8 ft.

Hint.—Remove the largest common factor before dividing.

5. $18 to $24; $24 to $18.
6. $\frac{1}{2}$ pt. to $\frac{1}{4}$ pt.; $\frac{1}{4}$ pt. to $\frac{1}{2}$ pt.
7. $\frac{3}{4}$ gal. to 3 qt.; 3 qt. to $\frac{3}{4}$ gal.
8. $9 to 90¢; 9 dimes to $9.
9. 5 in. to 12 in.; 1 ft. to 5 in.
10. 16 hr. to 1 da.; 1 da. to 16 hr.
11. 1 hr. to 1 min.
12. 1 wk. to 1 da.
13. 1 pt. to 1 gal.
14. 1 qt. to 1 bu.
15. $2\frac{1}{2}$ da. to 5 da.
16. 40 bu. : 32 bu.
17. \$$\frac{3}{4}$: \$$\frac{5}{8}$.
18. 75¢ : $1.
19. 15 da. : 20 da.
20. $5\frac{1}{2}$ lb. : 11 lb.
21. 50¢ : $16\frac{2}{3}$¢.
22. 40¢ : 50¢



Using this figure solve these examples.

1. If the value of A is \$2, find the value of B, of C, of D.

2. If B is $\frac{1}{2}$ sq. in., find the area of C, of D, of A.

3. If D is $\frac{1}{2}$, find the value of B, of C, of A.

4. If $\frac{1}{2}$ of A is $\frac{1}{16}$ sq. in., what is A?

5. If $\frac{3}{4}$ of B is $\frac{3}{8}$ sq. in., how much is B?

6. By drawing and cutting show that C is $\frac{1}{2}$ of D; that C is equal to B; that C is 4 times A.

Ratio Problems

In many problems time may be saved by finding the ratio between the term whose value is wanted and the term whose value is given.

1. If $\frac{1}{2}$ lb. of tea is worth 40¢, find the cost of $\frac{1}{4}$ lb. at the same rate.

HINT.—The cost of $\frac{1}{4}$ lb. is $\frac{1}{2}$ the cost of $\frac{1}{2}$ lb.

SOLUTION.—The cost of $\frac{1}{4}$ lb. $=\frac{1}{2}$ of 40¢ $=$ 20¢.

2. If a 10-acre field of wheat yields 265 bu., at this rate how much should a 5-acre field produce?

3. When 6 agate marbles are worth 50c, find the cost of 15 at the same rate.

4. At 47¢ per pk. of 15 lb. find the cost of a bushel of potatoes weighing 60 lb.

5. If a 30-lb. cheese is worth $10.20, find the cost of a 20-lb. cheese.

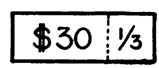
6. If $\frac{3}{4}$ of a farm is worth $12,000, find the value of $\frac{5}{16}$ of it. Hint—Compare $\frac{5}{16}$ with $\frac{3}{4}$.

7. A boy planted $\frac{1}{4}$ of his thrift garden in peas and $\frac{1}{3}$ in tomatoes. Compare the areas planted.

8. I told John that I had 9¢ in my pocket. He said, "That is only $\frac{3}{4}$ of my money." How much money has John?

9. A boy said he had attended school 160 days. The teacher said, "You were present $\frac{4}{5}$ of the school year." How can the boy find out how many days in the school year?

10. At a bargain sale a coat was sold for $30, which was $\frac{2}{3}$ of the regular price. What was the regular price?



HINT.—Often a diagram will take the place of an equation solution.

11. An auto driveway has 5 posts at equal distances apart. In a race one of the machines ran into the fourth post, which was 10 miles from the last one. How

many miles had the machine gone? What was the length of the roadway? Read your answer from the figure.

12. A son is 20 years old. The father said, "That is $\frac{2}{5}$ of my age." Find the father's age. Solve with a straight line figure.

Aliquot Parts

The following relations, called aliquot parts, occur often in arithmetic. Learn them and save yourself much work by using them in problem solving.

Learn these facts.

$2 = \frac{1}{50}$ of 100
$2\frac{1}{2} = \frac{1}{40}$ of 100
$3\frac{1}{3} = \frac{1}{30}$ of 100
$4 = \frac{1}{25}$ of 100
$5 = \frac{1}{20}$ of 100
$6\frac{1}{4} = \frac{1}{16}$ of 100
$8\frac{1}{3} = \frac{1}{12}$ of 100
$10 = \frac{1}{10}$ of 100
$12\frac{1}{2} = \frac{1}{8}$ of 100
$16\frac{2}{3} = \frac{1}{6}$ of 100
$20 = \frac{1}{5}$ of 100
$25 = \frac{1}{4}$ of 100
$33\frac{1}{3} = \frac{1}{3}$ of 100
$50 = \frac{1}{2}$ of 100

And these.

$100 = 2 \times 50$
$100 = 3 \times 33\frac{1}{3}$
$100 = 4 \times 25$
$100 = 5 \times 20$
$100 = 6 \times 16\frac{2}{3}$
$100 = 8 \times 12\frac{1}{2}$
$100 = 10 \times 10$
$100 = 12 \times 8\frac{1}{3}$
$100 = 16 \times 6\frac{1}{4}$
$100 = 20 \times 5$
$100 = 25 \times 4$
$100 = 30 \times 3\frac{1}{3}$
$100 = 40 \times 2\frac{1}{2}$
$100 = 50 \times 2$

Learn these facts.

$37\frac{1}{2} = \frac{3}{8}$ of 100
$62\frac{1}{2} = \frac{5}{8}$ of 100
$66\frac{2}{3} = \frac{2}{3}$ of 100
$75 = \frac{3}{4}$ of 100
$87\frac{1}{2} = \frac{7}{8}$ of 100
$40 = \frac{2}{5}$ of 100
$60 = \frac{3}{5}$ of 100
$80 = \frac{4}{5}$ of 100

Apply your knowledge of multiplication to test the truth of these statements.

$100 = \frac{3}{2}$ of $66\frac{2}{3}$
$100 = \frac{4}{3}$ of 75
$100 = \frac{8}{5}$ of $62\frac{1}{2}$
$100 = \frac{8}{3}$ of $37\frac{1}{2}$
$100 = \frac{8}{7}$ of $87\frac{1}{2}$
$100 = \frac{5}{2}$ of 40

The preceding table can be easily changed to become aliquot parts of one dollar: thus, $2¢ = \frac{1}{50}$ of \$1; $2\frac{1}{2}¢ = \frac{1}{40}$ of \$1; etc. Make such a table and use it in problem solving.

Examples

$1863 \times 16\frac{2}{3} = ?$

Long Method. Short Method.

$$\begin{array}{r} 1863 \\ \times 16\frac{2}{3} \\ \hline 1242 \\ 11178 \\ 1863 \\ \hline 31050 \end{array} \qquad \begin{array}{r} 31050 \\ 6\overline{)186300} \end{array}$$

Since $16\frac{2}{3} = \frac{1}{6}$ of 100, $1863 \times 16\frac{2}{3} = 186300 \div 6$.

Count all the steps by the **long** method. See how much you save by the **short** method.

Use a short method in each of these examples.

1. $84 \times 12\frac{1}{2} = ?$

2. $96 \times 33\frac{1}{3} = ?$

3. $72 \times 16\frac{2}{3} = ?$

4. $56 \times 75 = ?$

5. $1728 \times 33\frac{1}{3} = ?$

6. $24 \times 87\frac{1}{2} = ?$

7. 96 @ $16\frac{2}{3}¢ = ?$

8. 60 @ $3\frac{1}{3}¢ = ?$

9. $3424 \times 25 = ?$

10. $84 \times 25 = ?$

11. $125 \times 40 = ?$

12. $24 \times 66\frac{2}{3} = ?$

13. $144 \times 8\frac{1}{3} = ?$

14. $144 \times 33\frac{1}{3} = ?$

15. $256 \times 25 = ?$

16. 48 @ $12\frac{1}{2}¢ = ?$

17. 64 @ $6\frac{1}{4}¢ = ?$

18. $848 \times 12\frac{1}{2} = ?$

19. At $8\frac{1}{3}¢$ each, how many for \$3?

20. At 25¢ each, how many for \$10?

21. How many for \$12 at $66\frac{2}{3}¢$ each?

22. Count by $12\frac{1}{2}$'s to 100, by $6\frac{1}{4}$'s to 50.

23. Count by $16\frac{2}{3}$'s to 100, by $8\frac{1}{3}$'s to 50.

24. Count by 12's to 144, by 25's to 200.

25. Count by $3\frac{1}{3}$'s to 30, by $33\frac{1}{3}$'s to 200.

Everyday Problems

1. At $16\frac{2}{3}$¢ per yard, how much ribbon can I buy for \$1.00? for 50¢? for \$2.00?

2. When eggs are worth 50¢ per dozen, how many can be bought for \$2.00? for \$3.50? for 75¢? for 25¢?

3. If sugar is worth $8\frac{1}{3}$¢ a lb., how many pounds can be bought for \$1.00? for \$1.25? for 50¢? for \$1.50?

4. Find the cost of 24 baskets of grapes at $37\frac{1}{2}$¢ a basket? at $33\frac{1}{3}$¢ a basket? at 50¢ a basket?

5. Find the cost of 48 lb. of lard at 25¢ a lb.

6. At 50¢ a pk. find the cost of 4 bu. of potatoes.

7. Find the cost of 600 bu. of coal at $16\frac{2}{3}$¢ a bu.

8. How many quarts of berries at $12\frac{1}{2}$¢ a quart can I buy for \$1.00? for \$1.25? for \$2.00? for 75¢? for 50¢? for \$1.75?

9. At 25¢ per doz., how many dozen apples can be purchased for \$1.50? for \$2.00? for 75¢? for \$1.25?

10. \$10 will buy how many pounds at $33\frac{1}{3}$¢ per lb.?

11. \$2.00 will buy how much candy at $33\frac{1}{3}$¢ a lb.?

12. When oranges are 4 for 25¢, how many can John buy for 75¢? How many for \$1.25?

13. Six for \$1 is how many for \$1.50?

14. At 2 yards for 25¢ is how much for 75¢? for \$1.00? for \$1.50?

15. Find the cost of 160 acres of land at $\$62\frac{1}{2}$ an A.

16. Find the cost of 24 watermelons at 2 for 75¢.

17. When potatoes are selling at $37\frac{1}{2}$¢ a peck, how many bushels can I buy for \$3?

18. How many melons for one dollar at 2 for a quarter?

Testing Your Own Work or That of Others by Estimating the Result

It is worth while to be able to tell quickly when a result is about right. This will help you to find large mistakes in computing.

In this table are some results given by children. Study each example to see which result is most nearly correct. Then do the work to see if you selected the right one.

Examples	Results given		
1. $8\frac{1}{3} \times 12¢$	\$10	\$1.00	96¢
2. $56 \times 25¢$	\$140	\$1.40	\$14
3. \$84 ÷ 25¢	300	30	350
4. 64×99	6403	6000	6500
5. 46 pk. ÷ 4 pk.	$10\frac{1}{2}$	10 bu. 2 pk.	184
6. $21\overline{)364}$	30	14	18
7. 29 @ 30¢	\$8.00	\$90	\$8.80
8. $\frac{3}{4}$ of 88	660	66	6
9. $\frac{5}{6}$ of 720	60	6000	600
10. $11900 \div 17 =$	70	7000	700
11. $100 \times \$2.50 =$	\$2500	\$250	\$25
12. 420 @ $66\frac{2}{3}¢$	\$28	\$630	\$280
13. How many for \$5 @ 25¢ each?	200	125	22
14. 98×99	1000	10000	9872
15. $75 \times \$1.02$	\$75	\$765	\$76.50
16. 84 yd. ÷ $\frac{3}{4}$ yd.	63	112	105
17. $\frac{3}{4} + \frac{5}{8}$	$\frac{8}{12}$	$\frac{15}{32}$	$1\frac{3}{8}$
18. $\frac{2}{3} \times \frac{8}{24}$	$\frac{16}{72}$	$\frac{2}{9}$	$\frac{8}{36}$

III

Add as many as you can in 5 minutes.
Try to do better tomorrow.

1.	2.	3.	4.	5.	6.
3947	7892	4896	8390	3553	5377
8325	1040	2463	4099	6289	6292
6482	6238	2949	6253	2287	3462
9638	4892	6284	9246	3264	7385
4358	3622	4392	7839	5389	2462
2622	2363	6250	6284	2622	1963
8301	5248	9083	3392	5483	8424
5289	9099	5969	1564	9060	5689
6384	2262	7235	1763	5263	3562
7236	3104	6396	1888	7482	9842
5847	2042	5122	8881	9628	5620
2282	3969	2215	3089	3385	3356

IV

Work 6 minutes on this test. Then check your answers.

1.	2.	3.	4.	5.	6.
3004	2400	3070	4809	1000	9099
−2956	−1898	−1989	−3948	− 848	−8956

7.	8.	9.	10.	11.	12.
4002	5705	8001	7007	4000	3784
−3285	−4969	−7499	−3899	−3399	−2598

13.	14.	15.	16.	17.	18.
9004	3563	8472	5003	4001	5007
−8995	−2879	−3498	−2484	−3994	−3998

V

Multiply each of these examples by 25. Use the short method. Write products only.

1.	2.	3.	4.	5.	6.	7.	8.
348	524	856	848	372	256	144	296
9.	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**	**16.**
480	324	684	956	368	548	624	832

VI

In each of these examples, estimate your result before multiplying. In number one, you should be able to say, "My result will be more than 7000 (20×348) and less than 8700 (25×348)." Begin with the left hand digit of your multiplier. Why?

1.	2.	3.	4.	5.	6.	7.	8.
348	524	856	848	372	256	144	296
×24	×29	×26	×21	×22	×35	×19	×29

VII

Work 10 minutes on these examples. Then prove each result by long division. How may you know if your product is correct?

1.	2.	3.	4.	5.	6.
3564	8567	5674	5893	6742	5489
×489	×984	×908	×819	×838	×298
7.	**8.**	**9.**	**10.**	**11.**	**12.**
3049	5678	4352	5084	5389	6749
×786	×372	×287	×195	×258	×409

VIII

Find the correct quotient by inspection. Omit the remainder.

$254 \div 63$	$856 \div 95$	$726 \div 90$
$608 \div 102$	$569 \div 142$	$328 \div 116$
$958 \div 452$	$768 \div 151$	$963 \div 258$
$596 \div 329$	$804 \div 204$	$903 \div 316$
$562 \div 78$	$325 \div 64$	$389 \div 75$
$484 \div 120$	$496 \div 122$	$326 \div 54$
$666 \div 128$	$590 \div 150$	$509 \div 252$
$205 \div 74$	$362 \div 48$	$365 \div 58$
$916 \div 95$	$956 \div 95$	$389 \div 38$
$538 \div 64$	$628 \div 72$	$684 \div 73$

IX

$$\begin{array}{r} 291 \\ 35\overline{)10185} \\ \underline{70} \\ 318 \\ \underline{315} \\ 35 \end{array}$$

In solving a long division example, you will save time by not making the last multiplication if you find that the last trial dividend contains the divisor exactly. In the example, $10185 \div 35 = ?$, as soon as you found that 35 (the last partial dividend) contained the divisor once, the example was solved.

Find the quotients in these examples, using the suggestion above.

	a	b	c
1.	$81438 \div 98 = ?$	$19318 \div 26 = ?$	$15176 \div 28 = ?$
2.	$16907 \div 29 = ?$	$36096 \div 64 = ?$	$21170 \div 58 = ?$
3.	$14248 \div 26 = ?$	$34010 \div 38 = ?$	$16443 \div 29 = ?$
4.	$22848 \div 56 = ?$	$22940 \div 74 = ?$	$50107 \div 89 = ?$
5.	$23014 \div 74 = ?$	$18785 \div 65 = ?$	$5625 \div 75 = ?$
6.	$7225 \div 85 = ?$	$49914 \div 59 = ?$	$23986 \div 67 = ?$

X

There are 58 examples in this exercise. Write the answers for as many as you can in 15 min. Keep your record.

1. $\frac{3}{4}+\frac{1}{2}=?$
2. $\frac{7}{8}-\frac{3}{4}=?$
3. $\frac{2}{3}+?=1\frac{1}{3}$
4. $19-2\frac{1}{2}=?$
5. $8\times 3\frac{3}{4}=?$
6. $9\div\frac{2}{3}=?$
7. $4\div\frac{1}{3}=?$
8. $15\frac{1}{2}+5\frac{1}{2}=?$
9. $16\frac{1}{2}\times 2=?$
10. $24\div\frac{3}{4}=?$
11. $6-3\frac{5}{8}=?$
12. $\frac{3}{4}+\frac{1}{3}=?$
13. $\frac{5}{6}-\frac{1}{3}=?$
14. $7\frac{1}{2}\times 8=?$
15. $72\div ?=8$
16. $96\div 6=?$
17. $84\div ?=7$
18. $2\frac{2}{3}\times 12=?$
19. $2\frac{1}{2}\times 20=?$
20. $12\frac{1}{2}+87\frac{1}{2}=?$
21. $75+12\frac{1}{2}=?$
22. $?-25=12$
23. $12\div\frac{3}{4}=?$
24. $\$2\div 50¢=?$
25. $\$3\div 20¢=?$
26. 2 bu. ÷ 3 pk. = ?
27. 1 gal. ÷ 1 pt. = ?
28. $\$1\div 12\frac{1}{2}¢=?$
29. $50¢\div 16\frac{2}{3}¢=?$
30. $75¢\div 6=?$
31. 6 for $\$1\frac{1}{2}$ = 1 for ?
32. 8 for \$1 = 3 for ?
33. 9 for 27¢ = 6 for ?
34. 12 for 100¢ = 3 for ?
35. 18 for 50¢ = 9 for ?
36. 3 for \$2 = 6 for ?
37. 2 for 50¢ = 10 for ?
38. 16 for \$1 = 4 for ?
39. 16 for \$1 = 12 for ?
40. 3 for 10¢ = 12 for ?
41. 5 for 25¢ = 6 for ?
42. 12 for 50¢ = 3 for ?
43. \$8 for 12 = 3 for ?
44. \$10 for 12 = 9 for ?
45. At 2¢ each = ? for 20¢
46. At $2\frac{1}{2}$¢ each = ? for 10¢
47. At $\$2\frac{1}{2}$ each = ? for \$20
48. At $6\frac{1}{4}$¢ each = ? for 25¢
49. At $8\frac{1}{3}$¢ each = ? for 25¢
50. At $12\frac{1}{2}$¢ each = ? for 75¢
51. At 50¢ each = ? for \$2
52. At $\$\frac{1}{2}$ each = ? for 50¢
53. At $\$\frac{2}{3}$ each = ? for \$2
54. At 75¢ each = ? for \$3
55. At $\$1\frac{1}{2}$ each = ? for \$6
56. At 10¢ each = ? for \$2
57. At 5¢ each = ? for 30¢
58. At 25¢ each = ? for \$1.50

XI

Doing the Work without Re-writing

You should learn to add, subtract, multiply, or divide easy numbers without re-writing if they stand in a line.

Time yourself to see how long it will take to write answers for all the examples in this exercise. If you add from left to right, prove your answer by adding from right to left.

1. $8+3+2+5+6+7+5+6=?$
2. $1+9+8+3+7+5+6+2=?$
3. $6+5+2+3+8+7+9+4=?$
4. $27+38+64+50+15+32=?$
5. $89+64+33+72+18+25=?$
6. $72+5+34+6+19+31=?$
7. $173+6+27+120+16+75=?$
8. (*a*) $124-68=?$ (*b*) $732-158=?$ (*c*) $400-328=?$
9. (*a*) $2034-1565=?$ (*b*) $9046-1872=?$
10. (*a*) $100\div4\times12=?$ (*b*) $\frac{3}{4}\times72+18=?$

XII

Reviewing Short Methods in Multiplication

Each line shows a type already learned.

1. (*a*) $204\times356=?$ (*b*) $484\times503=?$ (*c*) $564\times207=?$
2. (*a*) $348\times20=?$ (*b*) $30\times678=?$ (*c*) $596\times40=?$
3. (*a*) $364\times25=?$ (*b*) $964\times25=?$ (*c*) $25\times832=?$
4. (*a*) $1023\times33\frac{1}{3}=?$ (*b*) $564\times33\frac{1}{3}=?$ (*c*) $33\frac{1}{3}\times855=?$
5. (*a*) $64\times12\frac{1}{2}=?$ (*b*) $128\times12\frac{1}{2}=?$ (*c*) $968\times12\frac{1}{2}=?$
6. (*a*) $36\times16\frac{2}{3}=?$ (*b*) $16\frac{2}{3}\times54=?$ (*c*) $1062\times16\frac{2}{3}=?$

XIII

The following items are taken from charge checks of one of the large department stores.

Write the answer to the nearest cent.

	a	b	c
1.	$5\frac{1}{4}$ yd. @ 35¢	$\frac{3}{4}$ yd. @ 25¢	$2\frac{1}{2}$ yd. @ 29¢
2.	$2\frac{1}{4}$ yd. @ 29¢	$2\frac{2}{3}$ yd. @ 49¢	$2\frac{1}{4}$ yd. @ 59¢
3.	$\frac{1}{2}$ yd. @ 75¢	$1\frac{1}{4}$ yd. @ 35¢	$1\frac{3}{4}$ yd. @ 39¢
4.	$1\frac{1}{2}$ yd. @ 35¢	$6\frac{1}{2}$ yd. @ 29¢	$3\frac{1}{2}$ yd. @ 35¢
5.	$1\frac{1}{4}$ yd. @ 89¢	$3\frac{1}{2}$ yd. @ 39¢	$6\frac{1}{2}$ yd. @ 39¢
6.	$5\frac{1}{2}$ yd. @ 25¢	$\frac{2}{3}$ yd. @ 29¢	$2\frac{1}{8}$ yd. @ $37\frac{1}{2}$¢
7.	8 yd. @ $37\frac{1}{2}$¢	$6\frac{3}{4}$ yd. @ 25¢	$1\frac{1}{2}$ yd. @ 39¢
8.	$\frac{3}{4}$ yd. @ 35¢	$40\frac{1}{2}$ yd. @ 10¢	$3\frac{1}{2}$ yd. @ 42¢

XIV

Finding the Missing Number

Read to a classmate the missing number indicated by the ? for as many as you can in 2 min.

1. $3+?=8$	12. $\frac{3}{4}$ of $?=9$	23. $25-12\frac{1}{2}=?$
2. $9-?=6$	13. 9 is ? of 18?	24. $?-18=30$
3. $6\times?=54$	14. $36\div?=3$	25. $50\div25=?$
4. $8\times9=?$	15. 18 is $\frac{3}{4}$ of ?	26. 8 bu. $\times ?=40$ bu.
5. $?\times4=28$	16. $50-?=35$	27. 15 qt. $\div ?=5$
6. $7\times3=?$	17. $?\times\$6=\$30$	28. $19+?=30$
7. $8\times?=4$	18. $\$18\div?=9$	29. $24-?=5$
8. $9\times?=63$	19. $44\times\frac{3}{4}=?$	30. $\frac{2}{3}\times?=4$
9. $50\div?=25$	20. $\frac{2}{3}\times?=6$	31. $\frac{3}{4}+?=1\frac{1}{2}$
10. $\$8\times?=\$48$	21. $\frac{1}{2}\times?=\frac{1}{8}$	32. $25¢-7¢=?$
11. $?\times4=\$80$	22. $\frac{3}{4}\times\$100=?$	33. $33\frac{1}{3}\times3=?$

XV

An Addition Race

Write the answers for these in 3 minutes.

	a	b	c
1.	$\frac{3}{8}+\frac{5}{8}=?$	$\frac{1}{2}+\frac{7}{8}=?$	$\frac{1}{4}+\frac{1}{2}=?$
2.	$\frac{1}{2}+\frac{1}{3}=?$	$\frac{2}{3}+\frac{7}{8}=?$	$\frac{2}{3}+\frac{3}{4}=?$
3.	$\frac{5}{12}+\frac{7}{12}=?$	$2\frac{1}{2}+3\frac{1}{2}=?$	$8\frac{1}{3}+5\frac{1}{4}=?$
4.	$6 \quad +3\frac{3}{4}=?$	$\frac{3}{4}+2\frac{1}{2}=?$	$\frac{5}{6}+\frac{3}{4}=?$

XVI

A Multiplication Race

Write the answers for these in 3 minutes.

	a	b	c
1.	$2\frac{1}{2}\times 5\frac{1}{2}=?$	$4 \quad \times 6\frac{3}{4}=?$	$5 \quad \times 2\frac{2}{3}=?$
2.	$1\frac{1}{3}\times 1\frac{1}{2}=?$	$4\frac{1}{2}\times 6 \quad =?$	$\frac{2}{3}\times \frac{5}{6}=?$
3.	$\frac{1}{2}\times \frac{1}{3}=?$	$2\frac{1}{2}\times \frac{1}{4}=?$	$\frac{1}{12}\times 2\frac{1}{3}=?$
4.	$3\frac{1}{3}\times 1\frac{1}{2}=?$	$\frac{8}{9}\times \frac{9}{8}=?$	$2\frac{1}{2}\times \frac{1}{2}=?$

XVII

A Fraction Test

Sixth grade pupils often miss some of these.
Can you do them all right the first time in 6 minutes?

	a	b	c	d
1.	$\frac{3}{4}+\frac{7}{8}=?$	$\frac{7}{8}-\frac{3}{4}=?$	$\frac{3}{4}\times \frac{7}{8}=?$	$\frac{3}{4}\div \frac{7}{8}=?$
2.	$2\frac{1}{2}+2\frac{1}{2}=?$	$2\frac{1}{2}-2\frac{1}{2}=?$	$2\frac{1}{2}\times 2\frac{1}{2}=?$	$2\frac{1}{2}\div 2\frac{1}{2}=?$
3.	$6+3\frac{3}{4}=?$	$6-3\frac{3}{4}=?$	$6\times 3\frac{3}{4}=?$	$6\div 3\frac{3}{4}=?$
4.	$1\frac{1}{2}+\frac{5}{6}=?$	$1\frac{1}{2}-\frac{5}{6}=?$	$1\frac{1}{2}\times \frac{5}{6}=?$	$1\frac{1}{2}\div \frac{5}{6}=?$
5.	$\frac{2}{3}+\frac{3}{4}=?$	$\frac{3}{4}-\frac{2}{3}=?$	$\frac{3}{4}\times \frac{2}{3}=?$	$\frac{3}{4}\div \frac{2}{3}=?$
6.	$2\frac{5}{12}+3=?$	$3-2\frac{5}{12}=?$	$2\frac{5}{12}\times 3=?$	$2\frac{5}{12}\div 3=?$

CHAPTER VI

HOW BUSINESS IS DONE

Making Change in Dry Goods Purchases

The following table shows the amount purchased and the money offered in payment by the customer.

Find the value of each purchase. Select in proper order the coins and bills needed for making change. State the amount of change.

Rule a sheet and do the work as shown below.

Value of Purchase + Change = Amt. given by the Customer.

Purchase	Value	Money Offered	Coins and Bills								
			1¢	5¢	10¢	25¢	50¢	$1	$2	$5	Change
1. $2\frac{1}{2}$ yd. @ 28¢	$.70	$1		1		1					$.30
2. $1\frac{1}{2}$ yd. @ 25¢		2									
3. $3\frac{3}{4}$ yd. @ 30¢		5									
4. $\frac{3}{4}$ yd. @ 49¢		2									
5. $1\frac{2}{3}$ yd. @ 12¢		1									
6. $5\frac{5}{8}$ yd. @ 60¢		5									
7. $\frac{1}{2}$ yd. @ 75¢		1									
8. $2\frac{1}{4}$ yd. @ 23¢		2									
9. 15 yd. @ $12\frac{1}{2}$¢		10									
10. 12 yd. @ 25¢		10									
11. $2\frac{1}{2}$ yd. @ 98¢		5									
12. $1\frac{1}{2}$ yd. @ $1.75		5									
13. $2\frac{1}{8}$ yd. @ 33¢		2									
14. $4\frac{2}{3}$ yd. @ $12\frac{1}{2}$¢		1									
15. 5 yd. @ $12\frac{1}{2}$¢		20									

Cash Sale Slips

In some stores the clerks make a sale slip like this one for each cash sale made.

JONES DRY GOODS CO.		
	Denver, Colo., July 15, 1920.	
Mrs. Mary Smith, 1842 Hartford St.		
Sold by Clerk No. 8.	**Amt. received, $2.00.**	
$3\frac{1}{2}$ yd. lace @ 20¢		$ .70
2 yd. muslin @ 18¢		.36
$1\frac{1}{2}$ yd. ribbon @ 12¢		.18
	Total	$1.24
	Change	.76
		$2.00

A CASH SALE SLIP

Make out cash sale slips in good form for the following purchases. Do not omit names, dates, etc.

1. A 12 lb. ham @ 35¢ a lb.; 5 lb. lard @ $22\frac{1}{2}$¢; $2\frac{1}{2}$ lb. bacon @ 37¢; $1\frac{1}{2}$ lb. steak @ 34¢. Money offered, $10.

2. 13 lb. meal @ $5\frac{1}{2}$¢; 12 lb. flour @ 7¢; 5 boxes grape nuts @ 13¢; 3 boxes shredded wheat @ $12\frac{1}{2}$¢. Money offered, $3.

3. Make a cash sale slip in good form for each of three purchases not to exceed $5 made at different stores or markets in your town.

When cash is paid on a debt, a receipt should always be asked for by the person paying the cash.

$6.00	Mt. Hope, Ohio, *Oct. 18, 1920.*
Received from *J. M. Fisher*	
Six Dollars	
for fourteen hours' typing.	
	Mary Martin.

A RECEIPT

A receipt should contain (1) the place and date, (2) the name of the person paying the money (payer), (3) the amount of money in figures and in words, (4) the purpose for which the money is paid, (5) the signature of the person receiving the money (payee).

Make a receipt in good form for each of these.

1. $1.00, one year's subscription to **Bird Lore.**

2. $1.50, part payment on account.

3. $1.00, for a baseball glove.

4. $1.50, for 6 hours' shoveling snow.

5. 40¢, 10 Saturday Evening Posts.

6. 10¢, membership in Junior Audubon Society.

7. $5.00, balance due on a bicycle.

8. 75¢, three hours' spading the neighbor's garden.

9. $4.50, balance on suit of clothes.

10. $1.10, balance borrowed from father on account of thrift stamp pledge.

Bills

A bill is a statement of amount due for service given, or for service and materials furnished, within a stated time.

	Detroit, Mich., *Aug. 1, 1919.*
J. A. King, 3731 Hartford St.	
To **BELL TELEPHONE CO.**, Dr.	
For telephone service during July, 1919.	$2.50

A BILL

The above bill was made by the Bell Telephone Co. and sent to Mr. King, Aug. 1, 1919. Mr. King may pay the bill in person, or he may send a money order for $2.50, or he may send his check for $2.50.

If he pays the bill in person with money, he should require the company to write these words "Rec'd payment Aug. 5, 1919, Bell Telephone Co." on the bill shown above. This is called receipting the bill. When a debt is paid by check such a receipt is not necessary. The check shows that the debt was paid.

1. W. A. Urban sharpened John Boyd's lawnmower, charging $1.00 for the work. Write and receipt the bill.

2. James Riggs, a carpenter, worked 2 days @ $4.50 a day repairing John Miller's house. He furnished $5 worth of lumber and other material. Write the bill which Mr. Riggs should send to Mr. Miller at the proper time.

A check is an order on a bank in which the signer of the check has money. This money is called a deposit. A check should not be written by anyone for a sum larger than the amount which the signer has on deposit.

Study the form below. Then try to write it with the book closed.

No. *1* Columbus, O., *Dec. 4, 1920.*

NEW FIRST NATIONAL BANK
OF COLUMBUS

Pay to the order of *The Ajax Telephone Co.* ($ *2.50*)

Two and 50/100 Dollars

John Rudy

A CHECK

1. Why can John Rudy write a check on the New First National Bank?

2. How large a check may he legally write on this bank?

3. Why is it convenient to pay debts with checks?

4. Write the check which Mr. King might have written in payment of his July telephone bill. See page 124.

Receipted Statements

Some people carry credit accounts at the department store, at the grocery, etc.

At the end of the month a statement is made by the seller and sent to the buyer.

Such a statement shows any balance due from the month before, the date of each purchase made during the month, the price and quantity of each article purchased, the total cost of each, and the total amount of the debt.

When payment is made, the statement is signed by the one receiving payment. This is called receipting the statement. Why is this important?

Each day's purchase is totaled and carried into the column on the right. Thus $1.15 is the total purchased on Oct. 9 and is therefore placed in this column.

In the following statement supply the missing items: (*a*), (*b*), (*c*), (*d*), (*e*), (*f*), (*g*), (*h*).

Cleveland, O., Nov. 1, 1920.

THE SPRING AVENUE MARKET
3105 Spring Ave.

Sold to Mrs. Jennie Good, 3731a Hartford St.

			$	c	$	c
Oct.	2	2 lb. sugar @ (*b*)		(*a*)		
	2	3 cans corn @ (*b*)		(*c*)		(*b*)
	9	2 bunches carrots @ 5¢		10		
	9	3 lb. roast @ 35¢	1	05	1	15
	13	10 lb. apples @ 2 lb. for 15¢		(*d*)		(*f*)
	25	2 lb. sugar @ (*b*)		(*a*)		(*g*)
	27	2 lb. butter @ 60¢	1	20	1	20
				Total		(*h*)

Received payment Nov. 3, 1920.
Spring Avenue Market.
per J. J.

A RECEIPTED STATEMENT

Using the form on page 126 make a receipted statement for each of these problems. Give the name of firm, dates, and prices where omitted.

1. During April Mrs. A. W. Jones made these purchases at the dry goods store.

Monday, 12 yd. of muslin @ ?; 8 yd. of gingham @ 40¢ a yd. (1918 price); 5 yd. of toweling @ 23¢.

Friday, 2 pairs of gloves @ ?; 6 spools of thread @ 6¢; 2 bolts of tape @ 12½¢; 5 cards of buttons @ 10¢.

Tuesday, 8 yd. of silk @ \$1.19; 1 tablecloth 2¼ yd. long @ \$1.25 a yd.; 2 pairs of hose @ 59¢.

She has on her April statement an unpaid balance from March of \$2.24.

2. Mrs. Geo. Day during October bought these groceries.

Saturday, 2 loaves of bread @ 11¢; 2½ lb. butter @ 70¢ (1918 price); 1 lb. coffee, 30¢; 2¼ lb. Ohio cream cheese @ 36¢; 1½ doz. eggs @ 65¢ (1918 price).

Wednesday, 3 loaves of bread @ ?; 24 lb. flour @ 6¢; 4 lb. corn meal @ 6¢; 2 lb. barley flour @ 5½¢.

Friday, 2 pecks potatoes @ 37¢; 10 lb. Ben Davis apples @ 4¢; 3 bunches carrots @ 5¢; 2 heads cabbage weighing 4 lb. each @ 4¢ a lb.

3. Plan and buy the groceries and meats for a family of four grown persons for November. At the end of the month make out the statement in correct form and show that it was paid in full on December 2.

4. What are the reasons for having a charge account at the corner grocery? What are the reasons against it?

CHAPTER VII

DOING BUSINESS WITH THE POST OFFICE

Classes of Mail Matter (In effect December, 1920)

1st class.	Letters, 2¢ an ounce or fraction thereof. Postal cards, 1¢.
2nd class.	Complete newspapers and magazines, 1¢ for 4 oz.
3rd class.	Printed matter, 1¢ for 2 oz. Printed matter in packages weighing 4 lb. or more is computed at the parcel post rate. Books to 8 oz.
4th class.	Parcel post. Printed matter weighing 4 lb. or more and merchandise. Books over 8 oz. take the zone rate. Small parcels of merchandise up to 4 oz. go at 1¢ to each oz. All others take the zone rate.

Parcel Post

The parcel post law in effect December, 1920, provides that packages weighing more than 4 ounces may be sent through the post office department at rates which vary for different distances of transportation. The cheapest rate is the local rate, applied to matter which is delivered from the same post office at which it is mailed. See the table on the next page for rates on different packages for the various zones.

The limit of weight for the local zone and the next three is 70 lb.; for all other zones it is 50 lb.

Parcel post packages may be insured. The amount of the fee depends upon the value of the package. A fee of 3¢ insures a parcel up to \$5, 5¢ to \$25, 10¢ to \$50, 25¢ to \$100.

Table showing rates for all the zones on weights to 10 lb.

Weight	Local	To 50 mi. 1st.	50 to 150 mi. 2nd.	150 to 300 mi. 3rd.	300 to 600 mi. 4th.	600 to 1000 mi. 5th.	1000 to 1400 mi. 6th.	1400 to 1800 mi. 7th.	1800 mi. and over 8th.
1 lb.	\$.05	\$.05	\$.05	\$.06	\$.07	\$.08	\$.09	\$.11	\$.12
2 lb.	.06	.06	.06	.08	.11	.14	.17	.21	.24
3 lb.	.06	.07	.07	.10	.15	.20	.25	.31	.36
4 lb.	.07	.08	.08	.12	.19	.26	.33	.41	.48
5 lb.	.07	.09	.09	.14	.23	.32	.41	.51	.60
6 lb.	.08	.10	.10	.16	.27	.38	.49	.61	.72
7 lb.	.08	.11	.11	.18	.31	.44	.57	.71	.84
8 lb.	.09	.12	.12	.20	.35	.50	.65	.81	.96
9 lb.	.09	.13	.13	.22	.39	.56	.73	.91	1.08
10 lb.	.10	.14	.14	.24	.43	.62	.81	1.01	1.20

TABLE I

1. A study of the table will show the rate of increase in a given zone for each 1 lb. increase. The same rate of increase holds until the largest weight for each zone is reached.

2. Parcels weighing 4 ounces or less do not take the parcel post rate. Such parcels go at 1¢ an ounce.

NOTE.—Ask the teacher to tell you the meaning of zones and also to show you how to draw circles with a cord and a crayon or pencil.

3. A fraction of a pound over is counted as a full pound. A parcel weighing 3 lb. 2 oz. takes the 4 lb. rate.

4. Parcels whose postage is 25¢ or more, not counting C. O. D. (collect on delivery), Insurance, or Special Delivery fees must also have on them war tax stamps as shown in the table below.

Parcels requiring 25¢ postage	1¢
Parcels requiring 26¢ to 50¢ postage,	2¢
Parcels requiring 51¢ to 75¢ postage,	3¢
Parcels requiring 76¢ to $1.00 postage,	4¢

For each additional 25¢ postage or fraction of it add 1¢ more.

5. Ask your postmaster to show you how he determines in what zone a given post office is in respect to your office.

Problems

1. Study the parcel post table shown on page 129 once more. Then complete it to the maximum for each zone. This is 70 lb. for zones ____ and 50 lb. for zones 4, __, __, __.

2. What is the cost of sending a 3 lb. parcel to a place in the 4th zone? to a place in the 7th zone? What is the additional insurance charge if this parcel is valued at $12?

3. John sent to a friend 800 miles away a 5-lb. box of chestnuts. What was the postage?

4. What is the total charge (insurance, war tax if in force, and postage) on a parcel of books, weight 10 lb., valued at $20, sent to the 4th zone?

5. Find the total charge on a 50 lb. shipment of butter, valued at $27.50, sent into the 3rd zone?

6. A Cleveland firm, during the day's business, mailed the following parcels. Compute the day's postage and war tax.

Weight	Distance or Zone	Weight	Distance or Zone
(*a*) 2 lb. 6 oz.	400 mi.	(*f*) 70 lb.	2nd zone
(*b*) 40 lb.	7th zone	(*g*) 12 lb.	700 mi.
(*c*) 1 lb. 2 oz.	1500 mi.	(*h*) 3 lb. 6 oz.	1st zone
(*d*) $5\frac{1}{2}$ lb.	200 mi.	(*i*) 8 oz.	3rd zone

7. Find the total mailing charge, consisting of three items, of the following Christmas packages.

Weight	Value	Distance or Zone
(*a*) $2\frac{1}{2}$ lb.	\$3.00	100 mi.
(*b*) 14 oz.	1.00	Local
(*c*) 3 lb.	2.00	8th zone

8. With a radius representing 50 miles using your post office as a center, draw a circle on a map showing your state and its boundary states. What can you say about all the cities, towns, and villages within this circle with respect to your post office?

9. Draw another circle with the same center as in the previous problem, but with a radius representing 150 miles. What can you say about the places lying between the boundaries of the 50-mile and the 150-mile circles?

10. A farmer in the local zone of a large city supplies his customers with fresh butter at 40¢ a pound. A family uses $2\frac{1}{4}$ lb. every week, costing in the city 60¢ a pound. What is the weekly saving if this family buys butter by parcel post?

A table showing the principal cities in each of seven zones with respect to St. Louis as a center.

1st zone.	East St. Louis; Alton, Ill.; Pacific, Mo.; St. Charles, Mo.
2nd zone.	Quincy and Springfield, Ill.; Terre Haute, Ind.; Jefferson City, Mo.; Burlington, Ia.; Evansville, Ind.; Paducah, Ky.
3rd zone.	Des Moines, Ia.; Topeka, Kans.; Springfield, Mo.; Chicago, Ill.; Cincinnati, O.; all cities of Tenn., except Knoxville and Chattanooga.
4th zone.	All Ohio, except Cincinnati; all Mich.; all Minn.; all Neb.; Wichita, Kans.; all Okla.; Dallas, Tex.; Shreveport, La.; Mobile, Ala.; Chattanooga, Tenn.; all W. Va.; Atlanta, Ga.
5th zone.	All Conn.; all N. J.; all Dela.; Baltimore, Md.; all Va.; Savannah, Ga.; Tampa, Fla.; Galveston and El Paso, Tex.; all Colo.; all Wyo.; all N. Dak.
6th zone.	All Me.; Boston, Mass.; Miami, Fla.; all Ariz. except Yuma; all Utah; Helena, Mont.
7th zone.	San Francisco, Cal.; all Ore.; all Wash.

Table II

Problems Based on Tables I and II

Do not omit the war tax if it is still in force.

1. A boy in Dallas, Tex., wishes to send his cousin in St. Louis a 3-lb. box of pecans. Find the postage.

2. A St. Louis merchant sent a 5-lb. parcel to a customer at El Paso, Tex. Determine the amount of postage.

3. What is the postage charge on a small box of grape fruit weighing 25 lb., shipped from Miami, Fla., to St. Louis?

4. A New York City girl sent her St. Louis aunt a Christmas parcel weighing 2 lb., valued at $3. Find the cost of postage and insurance.

5. Is it economical to send heavy packages by parcel post if they must go into the 4th zone or farther? What is a more economical way of sending such packages?

6. A St. Louis post office clerk during the forenoon of Jan. 22, 1920, received the following packages to be sent by parcel post.

Parcel	**Destination**	**Weight**	**Value**
1.	Dallas, Tex.	6 lb.	$10.00
2.	Springfield, Ill.	$2\frac{1}{2}$ lb.	3.50
3.	Richmond, Va.	10 oz.	1.00
4.	Des Moines, Ia.	15 oz.	20.00
5.	East St. Louis, Ill.	40 lb.	12.00
6.	Columbus, O.	35 lb.	18.00
7.	Washington, D. C.	14 lb.	25.00
8.	Alton, Ill.	60 lb.	2.00
9.	Salem, Ore.	$1\frac{1}{2}$ lb.	5.00
10.	Mobile, Ala.	20 lb.	8.00

a. Make six columns headed thus:

Parcel No. Zone No. Postage Insurance War Tax Total

b. Find (1) the postage, insurance, and war tax for each parcel, (2) the total cost of sending each parcel, (3) the total postage, total insurance, and total war tax of all the parcels.

CHAPTER VIII

DRAWING AND MEASURING LINES, SURFACES, AND SOLIDS

Measures of Length

1. Name the three **units of measure** which you have used in measuring length.

2. Which of these would you use in measuring each of the following: the length of a page in your book, the width of the top of your desk, the length of your school room, the length of dress goods, the width of the blackboard?

3. Look at your ruler and then tell the smallest length you can measure with it.

4. If the members of your class are not supplied with rulers, it is a good plan for each pupil to make one out of stiff cardboard, laid off in inches, halves, and quarters.

5. Measure to the nearest whole inch the length and width of the top of your desk.

6. Measure in feet and inches the length and width of the blackboard in your schoolroom. How much molding will it require to go around your board?

7. Make a yard measure out of a straight stick or stout cord and bring it to school.

8. Compare your yard measure with that of any three of your classmates. Is it exactly as long as any or all of these? Which one is most nearly correct? How may you be certain of it?

9. If your yard measure is very nearly correct, use it in measuring some convenient lengths about the school building.

10. In measuring long distances, large units of measure such as the rod and the chain (4 rods long) are used.

11. The mile is used as a convenient unit in computing distance. Did you ever walk a mile?

12. Draw a heavy line on the blackboard or on the floor exactly one rod long. Keep it for several weeks.

13. Estimate the length and width of the schoolroom floor in rods. Then measure in feet or yards to see how nearly correct you were.

14. Lay off on a stout cord a distance exactly one rod long. With this as a unit of measure find and record the dimensions of your playground; of your school grounds. You will need these records on pages 138 and 140.

NOTE.—In outdoor measuring it is convenient to divide the class into groups of three pupils. One should be at each end of the line or chain; the third should record the facts in a notebook for later use. See picture on page 134. Such material makes interesting exercises in scale drawing or in computing areas.

Learn these facts.

12 inches (in. or ″)	= 1 foot (ft. or ′)
3 feet	= 1 yard (yd.)
$5\frac{1}{2}$ yards or $16\frac{1}{2}$ feet	= 1 rod (rd.)
320 rods	= 1 mile (mi.)
5280 feet or 1760 yards	= 1 mile

Problems

1. How many one-yard lengths in 2 rods?

2. 640 rods = how many miles?

3. 4 rods = how many 11-foot lengths?

4. A young woman said, "There are 320 ft. in a rod." About what was she thinking?

5. A high school graduate said, "There are $16\frac{2}{3}$ ft. in a rod." How much did he miss it?

6. Mary said, "There are $5\frac{1}{2}$ ft. in a rod." How many of her rods in a real rod?

7. Another high school graduate said, "There are 5280 ft. in a rod." Do you think she knows the real rod?

8. A boy said, "There are $18\frac{3}{4}$ ft. in a rod." Was he guessing or did he know?

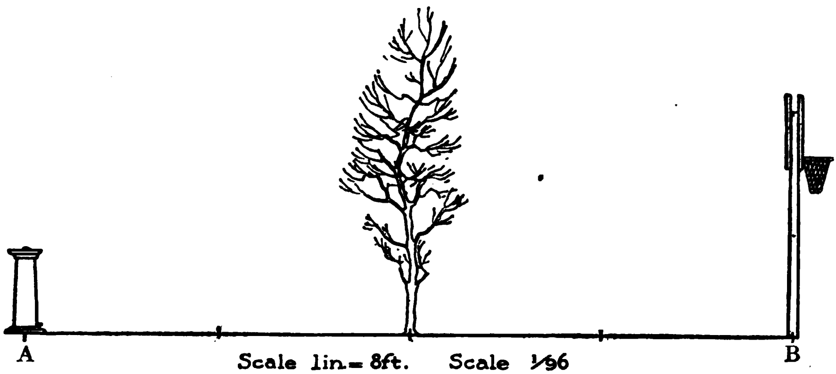
9. 6 inches are how many $\frac{3}{4}$-inch lengths?

10. A line 528 ft. long is what part of a mile?

11. How many 176-yard lengths in a mile?

12. Measure the length of your step in ordinary walking. Count the number of such steps in the length of your schoolroom.

13. Compute the length by stepping and compare this result with the measured length.



1. The distance between the drinking fountain and the basket ball post is 32 feet. This distance is said to be drawn to scale because each inch of the line in the picture represents 8 feet of the actual distance.

2. The scale may be shown by an equation or by a fraction. Both methods are used in the picture.

3. The scale in the picture is read thus: 1 inch of the line AB stands for 8 feet of the distance measured, or 1 unit of the line represents 96 such units of the distance measured.

4. How many feet is the little tree from the drinking fountain? How far is it from the post?

5. Draw the above picture using a scale of $\frac{1}{48}$. How long will line AB be in your drawing?

6. Draw the length of your blackboard to scale.

7. Draw each of the following to some convenient scale: 1 yard, 1 rod, 1 mile.

8. Surfaces are also drawn to scale. Such a drawing is called a plan or outline map.

9. The actual width of the oblong whose plan is shown in this figure is 10 ft. What is the actual length?

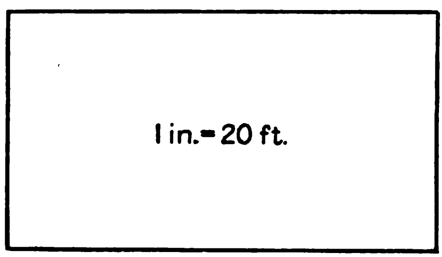
10. Compute the scale for the figure expressing it as an equation and as a common fraction.

11. Draw a plan of your schoolroom floor to a convenient scale.

12. Draw a plan of your blackboard to scale. Can you use the same scale you employed in Number 5?

13. Using the dimensions found in problem 14, page 135, draw a map of your school ground to a scale.

14. Room No. 1 of the Taussig Open Air School had in 1918 a garden the map of which is shown here.



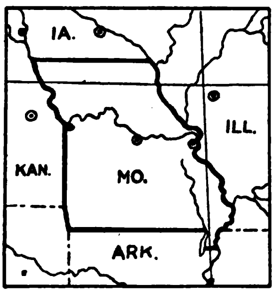
(1) Using the scale shown, find the length and width of the garden.

(2) The children decided to use their entire garden for tomatoes. They placed the plants exactly 3 feet apart each way. How many plants were there in a row on the border along the length? How many rows could they plant in their garden?

(3) They purchased 150 plants. How many had they left if none were lost in planting?

(4) The garden yielded 525 lb. of ripe tomatoes, which were sold at 6¢ a lb. What were the average earnings per plant?

Computing Distances by Means of a Scale



$\frac{9}{32}$ in. = 100 mi.

1. The figure shows a map of Missouri and part of the boundary states drawn to a scale in which $\frac{9}{32}$ inch represents 100 miles. Name these states and the cities shown by small circles.

2. How can you measure to the thirty-second of an inch with a ruler which shows only sixteenths?

3. Find the length of the northern boundary.

4. What is the shortest distance in miles between the Iowa line and the Arkansas line?

5. What is the distance between the southeast corner of Kansas and the mouth of the Ohio River?

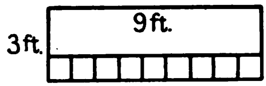
6. How far is it from Jefferson City to St. Louis? How far from Jefferson City to Kansas City?

7. How many miles from St. Louis to Des Moines, Iowa? From St. Louis to Springfield, Illinois?

8. Turn to the page in your geography on which the map of your state is shown. Find and read the scale. What does it mean? Find the greatest length and width of your state.

Measures of Surface

1. Name two units of measure which you have used in measuring surfaces.



2. In the oblong shown in the figure, how many square feet in one strip 9 ft. long and 1 ft. wide?

3. How many such strips?

4. The area = ___ × ___ sq. ft.

5. How many square feet in the floor of your schoolroom? The proper floor space per pupil is 15 sq. ft. Compare your floor space with this.

6. How many square inches of glass in one window of your schoolroom? How many in all the windows? The proper lighting surface per pupil is from $2\frac{1}{2}$ to 4 sq. ft. How does this compare with that of your schoolroom?

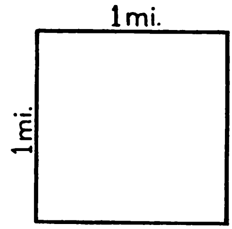
7. In measuring large surfaces it is more convenient to use the square yard and the square rod.

8. On the floor of your schoolroom at some convenient place lay off a square exactly 3 ft. long on each side. What name do you give this figure?

9. Using the measures obtained in problem 14, page 135, find the area of your playground in square feet. In laying off playgrounds 30 sq. ft. should be allowed for each child using the playground. How many square feet per child does your playground allow?

Learn these facts.

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
160 square rods (sq. rd.)	= 1 acre (A.)



1. This square represents one square mile or 640 acres of land. Such an area is called a section of land.

2. What are its dimensions in rods?

3. Find the scale to which the square is drawn.

4. An oblong, 160 rods long and 1 rod wide, contains an acre.

5. How many acres in a strip one rod wide across the section?

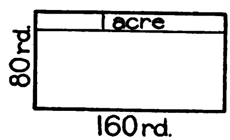
6. How many such strips in the section? How many acres?

7. How much is a quarter section of land? A half section? An eighth section?

8. Draw each of the areas named in No. 7 to scale.

9. How many rods around a section of land? How many around a quarter section?

10. $\frac{1}{4}$ sq. mi. = how many 40-acre farms? Draw a figure to help you. Find 40 acres in the figure above.



11. 800 sq. rd. = how many acres?

12. A field is 160 rd. long and 80 rd. wide. Find the area in acres.

HINT.—A strip 160 rd. long by 1 rd. wide contains an acre. How many such strips in the field?

13. Using a diagram, find how many acres in a field 80 rd. by 40 rd.

HINT.—A strip 80 rd. long and 2 rd. wide contains 1 acre.

14. A thrift garden 66 ft. long and 33 ft. wide contains what part of an acre?

HINT.—Change the dimensions to rods.

15. A field of wheat 80 rd. by 60 rd. averaged 24 bushels to the acre. Find the value of the crop at $2.10 per bushel.

16. A field 160 rd. by 160 rd. is what part of a section? Draw the field and the section to the same scale.

17. How many acres in a township 6 miles square?

18. How many acres in a street 2 miles long and 66 ft. wide?

19. A square field 80 rods long is divided into rectangular 5-acre tracts each 40 rd. long. Draw the field to scale, showing the tracts. Find the width of each lot.

20. If a map 10 inches wide and 16 inches long is made on a scale of 50 miles to the inch, what area in square miles is represented by the map?

21. Consider the map of Colorado a rectangle whose dimensions are $1\frac{3}{16}$ in. $\times \frac{13}{16}$ in. Find the length, the width, and the area of the state.

22. Call the map of New Mexico a square whose side is 1 inch. Find the area of the state. See the scale.

$\frac{9}{32}$ in. = 100 mi.

23. Name the three cities indicated by small circles on the map. Find out by means of the scale how many miles they are apart.

Draw the figure before you try to solve.

1. Which is larger, a square inch or a surface 1 inch square?

2. Which is larger, a 4-inch square or 4 square inches? How much? How may these figures differ in shape?

3. Compare a 3-foot square with 1 sq. yd.

4. After cutting a square inch out of one corner of a 3-inch square, what fractional part of the large square remains?

5. What is the largest square which can be cut out of a 5 in. by 3 in. oblong? What fractional part of the oblong is waste?

6. How many posts in a straight line 15 feet apart are required for a wash line 45 feet long?

7. How many posts 12 feet apart will be required for a fence around a rectangular lot 132 feet by 36 feet? Draw the figure and show the position of each post.

8. How many privet plants, 8 inches apart, are required to plant across a 30-foot lot and along each long side for 12 feet?

9. How many squares each $1\frac{1}{4}$ in. by $1\frac{1}{4}$ in. can be cut from a 5-inch square? How many can be cut out of a 6-inch square? Try it.

10. Find the area and perimeter of a $3\frac{1}{2}$-inch square.

11. How many feet of picture molding 2 inches wide are required for a rectangular picture 18 in. by 12 in.? Draw the figure.

12. What part of an acre is a rectangular lot 16 rods long and 55 yards wide?

Cubic Measure

Learn these facts.

1728 cubic inches (cu. in.)	= 1	cubic foot (cu. ft.)
27 cubic feet	= 1	cubic yard (cu. yd.)
128 cubic feet	= 1	cord of wood.

Refer to these facts when needed in problem solving.

1. A cubic yard of sand, gravel, or earth is called a load.
2. A gallon contains 231 cu. in.
3. A cubic foot of water contains about $7\frac{1}{2}$ gallons.
4. A cubic foot is about $\frac{4}{5}$ bushel.
5. A bushel contains about $\frac{5}{4}$ cu. ft.

1. A rectangular solid has length, breadth, and thickness; it has six faces, which are rectangles. Find in your schoolroom or elsewhere objects which are rectangular solids.

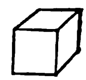


Fig. A

2. A solid having six equal squares for faces is a cube. See Figure A. If A represents a cubic inch, to what scale is it drawn?

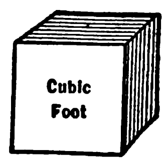


Fig. B

3. The volume of a solid is its contents measured in cubic units.

4. Figure B represents a cubic foot. Measure a front edge of it, and compute the scale to which it is drawn.

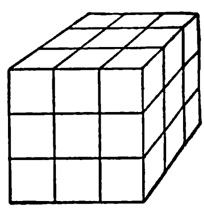
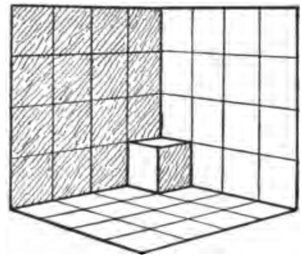


Fig. C

5. In making excavations and fills, the amount of earth moved is usually computed in cubic yards. Do you see why?

6. Figure C represents a cubic yard. Measure a front edge and compute the scale to which it is drawn.



1. Use the cubic inch as the unit of measure. Find out how many cubic inches in one row on the base of the figure.

2. How many such rows are there in one layer one inch high?

3. Then the volume of one layer is 4×4 cu. in.

4. How many such layers are there in the figure?

5. Then the volume of the whole figure (solid) is 4×16 cu. in.

The volume of a rectangular prism is the volume of its base one unit thick multiplied by the number of such units in its height.

6. Find the volume of a rectangular solid (prism) 8 inches long, 4 inches wide, and 3 inches high.

The volume = 32 cu. in. (Why?) $\times 3$ (Why?).

NOTE.—In finding the volume of a rectangular prism be sure to know the face on which the prism is resting.

7. How many cubic inches in a block 8 in. $\times$ 5 in. $\times$ 4 in.?

8. A certain solid is 8 in. long, 4 in. wide, and 2 in. thick. Find its volume. Do you know any such solids? Look for one and bring it to school.

9. How many faces on the solid in problem eight? The bottom and top faces are called the lower base and the upper base. Find the area of these bases. The other faces (How many?) are called lateral faces. Find their area, and call it lateral surface.

Measuring Some More Solids

Be sure you understand the meaning of the problem before you try to solve it.

1. How much larger is a 2-foot cube than 2 cu. ft.?

2. A boy took a one-inch cube out of the corner of a two-inch cube. What fractional part of the cube remained?

3. What is the ratio of the inch cube to 2 cu. in.?

4. How many cubes whose edge is $\frac{1}{2}$ inch can be placed in a cubical box which measures 2 inches each way on the inside?

5. A cubic foot of water weighs $62\frac{1}{2}$ pounds. Does a cubic foot of ice weigh more or less than $62\frac{1}{2}$ lb.? How do you know?

6. Which is heavier, a cake of ice 1 ft. $\times\frac{2}{3}$ ft. $\times\frac{1}{2}$ ft. or one 12 in. $\times$ 8 in. $\times$ 6 in.?

7. How many square feet in one face of a cube 1 yard long? In all its faces?

8. Cut loaf sugar often comes in $\frac{3}{4}$-inch cubes. Jane wished to pack 50 such cubes for use on a camping trip. She had two boxes. The inside dimensions of one were 3 in. $\times$ 6 in. $\times$ 2 in.; those of the other were 4 in. $\times$ 4 in. $\times$ 3 in. Which box should she select? Why?

9. What is the difference between a cubic yard and the volume of a rectangular granite block 4 ft. $\times 2\frac{1}{2}$ ft. $\times$ 3 ft.?

10. Which is larger and how much, a cubic foot or a rectangular block 16 in. $\times$ 8 in. $\times$ 12 in.?

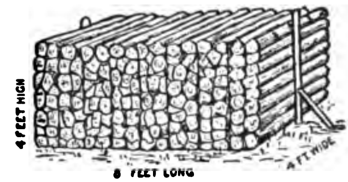
11. A 12-inch cube = ___ 4-inch cubes.

12. A 12-inch cube has ___ square faces, each containing ___ square inches.

1. In measuring wood the unit of measure commonly used is the cord. A cord of wood is a pile 8 ft. long, 4 ft. high, and 4 ft. or less wide.

2. This pile represents a cord of 4 ft. wood. How many cu. ft. in it?

3. Which has the larger volume, a cord of wood or a 5-foot cube?



A cord of wood.

4. How many cords of wood in a pile 32 feet long, 4 feet wide, and 4 ft. high?

HINT.—Look at the figure and then solve without pencil.

5. How many cords in a pile of wood 30 ft. long, 8 ft. high, and 4 ft. wide?

HINT.—Make a statement and use cancellation.

$$\text{The no. of cords} = \frac{30 \text{ cu. ft.} \times 8 \times 4}{128 \text{ cu. ft.}}.$$

6. At $5 per cord, find the cost of a pile of wood 16 ft. $\times$ 6 ft. $\times$ 4 ft.

7. A pile of 4-foot wood 4 feet high is said to contain 6 cords. How long should it be?

8. How many cords in a pile of wood 24 ft. long, 5 ft. high, and 4 ft. wide?

9. What are the dimensions of a pile of 4-foot wood containing $\frac{1}{2}$ cord? See the figure above.

10. A cord of 4-ft. wood contains 128 cu. ft. How many cu. ft. of wood in a cord when wood is cut into 3 ft. lengths? How many cu. ft. when the wood is cut into 2 ft. lengths?

Measures of Capacity

Dry Measure	Liquid Measure
2 pints (pt.) = 1 quart (qt.)	2 pints (pt.) = 1 quart (qt.)
8 quarts = 1 peck (pk.)	4 quarts = 1 gallon (gal.)
4 pecks = 1 bushel (bu.)	231 cu. in. = 1 gallon.

The standard bushel contains 2150.42 cu. in. Vegetables, fruits, and grain at present are commonly measured by the weighed bushel.

Problems

1. How many quarts in $1\frac{1}{4}$ bu.?

2. 24 qt. are what part of a bu.?

3. A boy bought a bushel of chestnuts for $2.50 and sold them at 2 qt. for 25¢. Find his profit.

4. Find the cost of 3 bu. 1 pk. of Ben Davis apples at $1.00 per bushel.

5. How many times can I fill a quart box from 1 bu. 3 pk. of cherries?

6. A cherry box is 4 in. square at the bottom. How deep must it be to hold one quart?

7. Which is larger and how much, the dry quart or the liquid quart?

8. A grocer sold cranberries at 6¢ per dry quart. In measuring, he used a liquid quart. Who benefited by the mistake?

9. Jim, the elephant at the Zoo, eats $1\frac{1}{3}$ pk. of oats and 100 lb. of hay every day. If oats are worth 80¢ a bu. and hay $30 a ton, what is the cost of this feed for a week? What is the cost for July?

10. A water trough is $12\frac{1}{2}$ ft. long, 4 ft. wide, and 3 ft. deep. How many gallons in it when $\frac{3}{4}$ full?

11. The inside measurements of a cubical box are 8 inches. Will it hold a peck?

12. A box is 4 in. $\times$4 in. $\times$4 in. Is it more nearly or less nearly a dry qt. than a liquid qt.?

13. A box full of apples is 14 in. square at the bottom and 12 in. deep. Which would you rather have at the same price, a bushel or this box?

14. About how many gallons in a cubic foot?

15. Will 400 quarts of oats last 9 horses a week if each horse is fed 6 quarts a day?

16. Ice weighs $57\frac{1}{2}$ lb. to the cu. ft. The inside measurements of my ice box are 12 in. $\times$12 in. $\times$8 in. How shall I order ice if it is sold in 25 lb. pieces, in 50 lb. pieces, and in 75 lb. pieces?

17. I have a small rectangular vessel 7 inches by 11 inches by 6 in. Will it hold 2 gallons? How do you know?

18. If the rainfall was an inch in one hour, how much water measured in gallons fell on a rectangular thrift garden 40 ft. $\times$20 ft.?

19. There are in our school 8 window boxes each 3 ft. long, 8 in. wide, and 6 in. deep. Will one load of good soil fill them? (A load is one cu. yd.)

20. At 50¢ a load (cubic yard), find the cost of removing the earth from a rectangular excavation 18 ft. long, 15 ft. wide, and 6 ft. deep.

Hint.—Many children do this one without a pencil. Can you?

A Little Test in Units of Measure

Name the unit used in measuring each of the following.

1. Wheat when the crop is estimated by the farmer; when bought for chicken feed.

2. Coal when bought by the wholesale dealer; when bought by the average householder; when bought by the very poor.

3. Sugar bought by the grocer; sold by the grocer; used at the table.

4. Potatoes when sold by the grower; when bought at the grocery.

5. Flour sold in large quantities; sold in small quantities.

6. Milk measured at the dairy on the farm; sold at the grocery; used at the table.

7. Water in large reservoirs; in making spraying solutions; at the table.

8. The surface of a window pane; the blackboard surface; thrift gardens; farms; counties; states.

9. The rate a man walks; the rate of a very fast train.

10. The dimensions of your desk top; of the floor; of a field; of a county.

11. Contents of a small box; volume of the schoolroom; of an excavation for a house; of a pile of wood.

12. Apples sold by the grower; sold by the grocer.

13. Tea sold by the grocer; measured in the kitchen.

14. Cranberries bought by the grocer; sold by him.

15. Oranges sold by the grower; bought at the corner grocery; served at the table.

16. Sweet pickles bought by the grocer; sold by him; served at lunch.

CHAPTER IX

PRACTICE FOR SPEED AND ACCURACY

I

Addition

Write the answers on a folded slip of paper laid below the examples.

See how many of these examples you can do right in 8 minutes. If you are a fifth grade pupil, good in addition, you should have 7 right. Some 5th grade pupils have done 12 right.

208	217	586	359	803	597
984	173	324	235	924	383
352	538	247	714	652	708
745	625	170	129	260	227
497	209	958	647	545	474
176	994	435	280	381	566
569	380	913	486	769	690
623	456	692	592	827	815
838	661	709	678	138	189

842	539	975	908	751	648
287	673	457	762	839	276
940	927	293	273	986	382
694	135	709	537	474	401
738	278	648	154	318	514
429	892	126	891	563	720
365	506	561	389	635	199
506	764	834	616	147	865
179	410	397	445	292	907

II

Subtraction

This test contains all of the 90 subtraction facts.

All right in 8 minutes.

80314	92785	87600	51400	82325	58496
46349	44159	22735	28271	35814	12743
93832	91721	64354	90323	75427	54101
32105	14412	45858	62665	48328	51519
98719	76645	97666	95621	808021	3347
87916	22447	16569	92082	658877	2617

III

Multiplication*

The next eight examples contain all the multiplication facts from 2×2 to 9×9. All right in 8 minutes.

4357	8692	7398	2645	2645	8739	7534	6982
$\times 74$	$\times 37$	$\times 29$	$\times 92$	$\times 54$	$\times 45$	$\times 86$	$\times 68$

IV

Division

A 5th grade pupil, good in division, should do 6 right in 10 minutes. After the test, solve those you did not try and prove the answer for all of them.

$28\overline{)8204}$ $65\overline{)45825}$ $58\overline{)51736}$ $94\overline{)38634}$ $47\overline{)39997}$ $36\overline{)23076}$

$74\overline{)48100}$ $25\overline{)12075}$ $93\overline{)69006}$ $76\overline{)29184}$ $49\overline{)34986}$ $52\overline{)14196}$

* NOTE.—Copy these two exercises from the teacher's dictation, leaving proper space between the examples for the work.

V

See how many of these you can do right in exactly 3 min.

6 right is a good score. Some 5th grade children have done 12 right in 3 min.

Do them without written work if you can.

	a	b	c
1.	$\frac{3}{4}+\frac{1}{6}=$	$\frac{5}{8}-\frac{5}{12}=$	$\frac{2}{3}\times\frac{3}{4}=$
2.	$\frac{3}{4}\div\frac{1}{8}=$	$\frac{5}{6}+\frac{3}{8}=$	$\frac{7}{8}-\frac{3}{4}=$
3.	$\frac{5}{8}\times\frac{16}{24}=$	$\frac{2}{3}\div\frac{5}{12}=$	$\frac{11}{12}+\frac{2}{3}=$
4.	$\frac{5}{8}-\frac{3}{16}=$	$\frac{3}{4}\times\frac{20}{32}=$	$\frac{3}{8}\div\frac{3}{16}=$

VI

1. Write as many correct answers as you can in 3 min. by lines.

2. On a separate sheet write as many correct answers as you can in 3 min. by columns.

3. Compare the two sets of answers.

	a	b	c	d
1.	$8+7=$	$7\times7=$	$8\times9=$	$3\frac{1}{3}+2\frac{2}{3}=$
2.	$3\times4=$	$50-25=$	$7\times6=$	$5\frac{1}{2}+5\frac{1}{2}=$
3.	$16\div2=$	$3\times25=$	$36\div9=$	$\$\frac{1}{2}+25¢=$
4.	$\frac{1}{3}+\frac{2}{3}=$	$48\div8=$	$\frac{2}{3}$ of $18=$	$2-\frac{1}{4}=$
5.	$4-2\frac{1}{2}=$	$\frac{2}{3}\times12=$	$\frac{3}{5}$ of $25=$	$3\frac{1}{3}\times3=$
6.	$9\times9=$	$\frac{1}{2}+\frac{3}{4}=$	$36-24=$	$9\times10=$
7.	$56\div7=$	$4\times1\frac{1}{2}=$	$72\div9=$	$5\times9=$
8.	$\frac{1}{3}$ of $36=$	$6\times3=$	$100-75=$	$63\div7=$
9.	$4+3+7=$	$\frac{1}{3}$ of $27=$	$100\div10=$	$64\div8=$
10.	$8+4-5=$	$24+26=$	$\frac{5}{6}\times24=$	$15+5=$

VII

1. Convert each of the following into a fractional part of a yard:

	a	b	c	d
1.	4 in.	30 in.	24 in.	12 in.
2.	$4\frac{1}{2}$ in.	6 in.	18 in.	10 in.
3.	1 ft. 4 in.	8 in.	2 ft. 4 in.	1 ft. 3 in.

2. Change each of the following fractional parts of a yard into inches:

$\frac{4}{9}$ $\frac{7}{9}$ $\frac{2}{3}$ $\frac{1}{2}$ $\frac{3}{4}$ $\frac{1}{8}$ $\frac{5}{8}$

$\frac{7}{8}$ $\frac{5}{9}$ $\frac{5}{12}$ $\frac{11}{12}$ $\frac{5}{18}$ $\frac{17}{18}$

3. Add $\frac{3}{4}$ to each of the following:

$\frac{1}{2}$ $\frac{1}{4}$ $\frac{2}{3}$ $\frac{5}{6}$ $\frac{1}{3}$ $\frac{5}{12}$ $\frac{1}{8}$

$\frac{5}{8}$ $\frac{7}{12}$ $\frac{11}{12}$ $\frac{15}{16}$ $\frac{7}{8}$ $\frac{13}{16}$ $\frac{1}{24}$

$\frac{19}{24}$ $\frac{11}{24}$ $\frac{11}{32}$ $\frac{1}{32}$ $\frac{3}{8}$ $1\frac{1}{2}$ $3\frac{5}{8}$

4. Subtract $\frac{3}{4}$ from each of the following:

$\frac{7}{8}$ $\frac{11}{12}$ $1\frac{1}{4}$ $1\frac{2}{3}$ $\frac{13}{16}$ $2\frac{1}{8}$

$\frac{15}{16}$ $4\frac{1}{3}$ $5\frac{3}{8}$ $1\frac{1}{2}$ $10\frac{1}{8}$

5. Count by $\frac{3}{4}$'s to 12; by $\frac{7}{8}$'s to 7.

6. How many $\$\frac{3}{4}$ in each of the following amounts: \$3? $\$3\frac{3}{4}$? $\$2\frac{1}{4}$? \$6? $\$7\frac{1}{2}$? \$12? \$9? $\$10\frac{1}{2}$? $\$8\frac{1}{4}$?

7. a. $\frac{3}{4}+\frac{5}{6}=?$ b. $\frac{3}{4}\div\frac{5}{6}=?$ c. $\frac{3}{4}\times\frac{5}{6}=?$

8. 3 ft. is what part of 8 ft.? How often is 2 oz. contained in 2 lb.?

9. Among how many children can I distribute 25¢, giving each child 2 pennies?

10. One boy said, "2 times $\$\frac{3}{4}$ equals $\$\frac{3}{2}$." Another said, "3 times $\$\frac{3}{4}$ equals $\$\frac{6}{4}$." Which one was right?

VIII

1. Mr. J. M. Rice in 1902 gave the following problem to 1593 children. Only 892 of them knew how to solve it, and 765 of these had the right answer. Read it carefully to see if you know how without getting help from some one. Then try it.

"Frank had \$3.08. He spent $\frac{1}{4}$ of it for a cap, $\frac{1}{7}$ of it for a ball, and the remainder for a book. What did the book cost?"

2. If you are not in the 756 class, try this one.

Mary's mother sent her to the store with 75¢ telling her to buy $\frac{2}{3}$ yd. of gingham at 75¢ a yd., and $\frac{1}{2}$ yd. ribbon at 30¢ a yd., and to spend the change for candy if she wished. How many sticks at a penny each could she buy with the change?

3. Three men bought for \$6.00 a barrel of apples, whose net weight was 150 lb. The first paid \$1.20; the second, \$1.80; the third, \$3. How should they divide the apples?

4. A boy averages 30 minutes at home study per day for 190 school days. How many hours does that make?

5. Frank's father bought 8500 lb. of coal at \$6 per ton. Can you find the cost? How?

6. Hard coal is sometimes delivered in 100-pound sacks. How many sacks should I expect if I order 8 tons?

7. A boy after school hours during the trapping season caught 32 muskrats whose skins he sold as follows: 16 at 75¢ each; 8 at 50¢ each; and 8 at 35¢ each. How much did he get for all of the skins, and what was the average price per skin?

8. How many minutes does it take a stenographer to write 12,000 words if she writes 110 words a minute? How many hours?

9. A cottage was built for the following costs: foundation and brickwork, \$425.00; lumber and mill work, \$1120.00; plumbing, \$350; painting, \$98.00; hardware, \$56.85; carpentering, \$576.50; lathing and plastering, \$235.75. What did the cottage cost when completed?

10. A clerk's expenses for a month are as follows: room, \$8.50; board, \$21.50; laundry, \$2.75; carfare, \$3.00; other expenses, \$8.25. How much can he save out of a monthly salary of \$70?

11. How many rods of fence are required to enclose a field in the form of a rectangle whose length is $50\frac{3}{4}$ rods and whose width is $32\frac{7}{8}$ rods?

12. If 5 acres yield $7\frac{1}{2}$ tons of clover hay, what is the average yield per acre?

13. A merchant bought children's slippers at \$7.50 per doz. pairs and sold them at \$1 per pair. What part of a dollar did he gain on each pair? How much on 2 doz. pairs?

14. If I travel $2\frac{2}{5}$ miles in $\frac{4}{5}$ of an hour, at the same rate how far will I travel in $2\frac{1}{2}$ hours?

HINT.—Compare $2\frac{1}{2}$ hr. with $\frac{4}{5}$ hr.

15. John and James went fishing. John caught a $3\frac{3}{4}$-lb. fish, and James caught one weighing 3 lb. 10 oz. Who caught the larger fish? What part of a pound larger?

16. If 12 acres of wheat yield $332\frac{1}{2}$ bu., what is the average per acre?

IX

Write your answer in a good sentence.

1. If you know what part of the earth's surface is water, how can you find what part is land?

2. If you know the cost of a yard of cloth and the number of yards in a bolt, how can you find the value of the entire bolt?

3. Given the cost of a dozen, find the cost of $1\frac{1}{2}$ doz.

4. Given the cost of one pound of butter and the amount of money spent, find the number of pounds bought.

5. If you know what part of a mixture by weight is flour and what part is water, how can you tell if there is anything else in the mixture?

6. Knowing the weight of each child in a group of five, how do you find the average weight?

7. How can you find the number of gallons in a rectangular water trough, knowing the dimensions in feet?

8. If you know the dimensions of a pile of wood, how do you find the number of cords in the pile?

9. Knowing the cost of milk per gallon and the price at which it is sold per quart, how do you find the loss or gain per gallon?

10. If a newsboy knows how many papers he has and how many he sold, how can he find out how many he had at first?

11. If Mary knows how many questions in a test she answered right, how can she find out what fractional part of the whole test she missed?

X

The following is the Rice test given in 1902 to 1593 fifth grade children. The average for the best 5th grade class was 78%; for the poorest it was 45.6%; the average of all the 5th grade classes was 69.4%. Try to solve this list in 50 minutes. Find out if you stand above or below the average.

1. A man bought a lot of land for $1,743, and built upon it a house costing $5,482. He sold them both together for $10,000. How much did he make?

2. How many feet long is a telegraph wire extending from New York to New Haven, a distance of 74 miles? There are 5,280 feet in a mile.

3. A merchant bought 15 pieces of cloth, each containing 62 yards. He sold 234 yards. How many dress patterns of 12 yards each did he have left?

4. What will 24 quarts of cream cost at $1.20 a gallon?

5. If a boy pays $2.83 for a hundred papers and sells them at 4 cents apiece, how much does he make?

6. If I buy 8 dozen pencils at 37 cents a dozen, and sell them at 5 cents apiece, how much money do I make?

7. A flour merchant bought 1,437 barrels of flour at $7 a barrel. He sold 900 of these barrels at $9 a barrel, and the remainder at $6 a barrel. How much did he make?

8. Frank had $3.08. He spent $\frac{1}{4}$ of it for a cap, $\frac{1}{7}$ of it for a ball, and with the remainder he bought a book. How much did the book cost?

PART II—SIXTH YEAR

CHAPTER I — DECIMAL FRACTIONS

The Meaning of Decimal Numbers

Our Money System	Our Number System
10 mills = 1 cent	10 ones = 1 ten
10 cents = 1 dime	10 tens = 1 hundred
10 dimes = 1 dollar	10 hundreds = 1 thousand

1. Look at the two tables to see if this statement is true: "Ten units of one order make one of the next larger."

2. Any number system built on the plan of ten is called a decimal system. For this reason our number system is called a decimal system. It is also called the Arabic system because the Arabs first brought it to Europe.

3. In our number system we can write any number with these figures (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) and the decimal point (.).

4. The value of a figure* in a number depends on the place it occupies in the number. In \$2.22 each 2 has a different value. What is it?

5. How does the figure 2 differ in value in each of its positions in \$222.22?

6. Where must a figure stand with respect to the decimal point if it has a large value? Where if it has a small value?

* The figures in a number are also called **digits.**

7. What is the largest sum of money which can be represented in dollars by the figures 1 and 9 if you write them only once? What is the smallest sum? What is the smallest sum if you use the decimal point?

8. Using each of the 10 figures but once, write the largest possible number.

9. In what order did you have the figures in example number 8? Place these figures to the right of the decimal point in the order found in example 3. You have now written the smallest possible number using each figure but once.

10. A number standing entirely to the left of the decimal point is called a decimal integer, as **24.**

11. A number standing wholly to the right of the decimal point is a decimal fraction, as **.24.** Write five decimal fractions.

12. A number standing in part on one side and in part on the other side of the decimal point is a mixed decimal, as **24.5.** Write 5 mixed decimals.

13. Any number written in the decimal system is a decimal number.

14. The decimal point is the place from which to count in our system. Every number to the left of it is a decimal integer, and every number to the right is a decimal fraction.

Writing Large Numbers

1. You have learned to write and read numbers consisting of units and thousands periods. You will now need to learn two more periods, called millions and billions.

Billions' Period.			Millions' Period.			Thousands' Period.			Units' Period.		
Hundred-billions	Ten-billions	Billions	Hundred-millions	Ten-millions	Millions	Hundred-thousands	Ten-thousands	Thousands	Hundreds	Tens	Units
8	4	3	4	2	9	6	7	8	3	4	2

2. The number in the table is read 843 billion 429 million 678 thousand 342.

3. In the writing of numbers having five or more places, the comma is usually employed to separate the periods as an aid in accurate and rapid reading. When the names of the periods are expressed in words, as in Number 2, the comma is unnecessary, and therefore should be omitted.

4. Write each of these numbers in figures.

Ten million eight hundred thousand two hundred thirty-four.

Forty million. Six hundred three thousand ten.

Thirty thousand two. Sixteen thousand fifty.

Twenty-four billion. Six billion eighty million.

Reading Large Numbers

Name the periods in the number. Then read it.

Do not use **and** in reading whole numbers.

	a	b	c	d
1.	805,674	15,622,000	84,007,410	24,304,700,000
2.	9,842,374	35,040,622	120,348,624	64,080,924,304
3.	12,348,607	52,308,048	8,000,000,000	108,256,384,926

Read the Following Paragraphs

1. The amount of money spent by the United States Government in 1919, was about $24,000,000,000.

2. Of this amount $8,000,000,000 were raised by taxation, leaving $16,000,000,000 to be raised from the sale of bonds.

3. In 1918 there were in the United States 10 families whose average annual income was $10,284,000.

4. Subscriptions to the Second Liberty Loan of 1917 in the twelve Federal Reserve districts were made as shown on the side. Make a complete sentence for each subscription, thus: Boston Federal Reserve District subscribed 476 million; etc. Find the total and read it. Why could the New York district subscribe for more than any other?

Boston	$ 476,950,050
New York	1,550,453,450
Philadelphia	380,350,250
Cleveland	486,106,800
Richmond	201,212,500
Atlanta	90,695,750
Chicago	585,853,350
St. Louis	184,280,750
Minneapolis	140,932,650
Kansas City	150,125,750
Dallas	77,899,850
San Francisco	292,671,150

5. The surface of the earth contains 196,907,000 sq. mi., of which 144,500,000 sq. mi. are water.

6. In 1918, the food for our army cost $425,000,000.

7. In August, 1918, 27,527,500 pounds of potatoes and onions were sent to our men in the camps in this country.

8. About 200,000 lb. of lemon drops were furnished our army in less than two years.

9. The population of Chicago, Ill., in 1920 was 2,884,827.

1. John spent \$.25 for a top, \$.10 for some marbles, \$.05 for a pencil, and \$.01 for some cord. How much did he spend?

\$.01 is also read one hundredth dollar.
\$.05 is also read 5 hundredths dollar.
\$.10 is also read 10 hundredths dollar.
\$.25 is also read 25 hundredths dollar.

2. Write these numbers as hundredths of a dollar: 6¢, 15¢, 45¢, 75¢, 90¢, 62¢, 50¢, 2¢, 72¢.

3. 10 mills = 1 cent. 1 mill = $\frac{1}{10}$¢, also written .1¢.
10 cents = 1 dime. 1 cent = $\frac{1}{10}$ dime, also written .1 dime.
10 dimes = 1 dollar. 1 dime = \$$\frac{1}{10}$, also written \$.1.

4. Read these decimal fractions: \$.01, \$.1, \$.10, .1¢, .8¢, \$.8, .1 dime, \$.25.

5. Read: .1 ft., .03 ft., .05 yd., .5 yd., .66 mi., .75 yd., .45 ton, .9 ton.

6. Write tenths and hundredths of other units of measure which you know.

7. Read: .8 .08 .1 .01 .6 .66 .60 .10 .99 .9

8. 1 mill is $\frac{1}{1000}$ of a dollar, also written \$.001, read one thousandth dollar.

9. Write as decimal parts of a dollar: 6 mills, 3 mills, 8 mills, 2 mills, 9 mills.

10. In \$11.111 what is the value of each 1?

11. Which 2 in \$22.222 stands for the largest value? Which 2 stands for the least value?

12. Which 2 in 2.22 mi. stands for the longest distance? Which for the shortest?

13. Which is larger, \$22 or \$.22? \$.22 or \$.022?

14. In \$22.22 each 2 is worth 10 times as much as the next to the right. That is, 10 2's of one place make one 2 of the next place to the left.

15. In decimal fractions just as in decimal integers 10 units of one place make one unit of the next larger place.

16. Decimal fractions are built on the 10's plan.

17. Read: \$22, \$2.2, \$.22, \$.022. Beginning at \$.22, how is each number obtained from the previous one?

18. Is this statement true? A figure standing one place to the **left** of one's place represents a value 10 times as large as it does in one's place; but standing one place to the **right** of one's place, it represents a value only $\frac{1}{10}$ as large as it does in one's place.

•**19.** Compare the **value** of a figure standing in the **second** place to the left of one's place with its value in one's place. Compare the value if it stands in the second place to the right of one's place.

20. The decimal point shows the position of ones with respect to the orders to the right of it.

21. In 2.22 what is the value of each 2?

22. State the value of each 3 in 33.3. In 3.33. In .333.

23. In example 22 how are the last two numbers obtained from the first one?

24. Up to this time nearly all the numbers you used were found on the left of the decimal point. Such numbers are whole numbers, or integers, strictly speaking, decimal integers because they stand in a decimal system.

25. There are many numbers to the right of the decimal point. Such numbers are called decimal fractions, or ecimals for short.

26. A number which stands partly on one side of the decimal point and partly on the other side is called a mixed decimal. 3.5, 8.75, and 16.3 are mixed decimals.

27. Write 10 mixed decimals, 10 decimal integers, 10 decimal fractions.

Reading Decimals

thousands	hundreds	tens	units	(and)	tenths	hundredths	thousandths	ten-thousandths
2	2	2	2	.	2	2	2	2

1. Learn the orders to 4 places to the right of the decimal point.

2. This number is read 2 thousand 222 and 2 thousand 222 ten-thousandths.

3. The numerator of decimal fractions is expressed. What is it in the figure?

4. The denominator (name of the numerator) is indicated by the number of places the last figure of the numerator is removed from the decimal point. One place is **tenths**; two, **hundredths**; three, **thousandths,** etc.

5. A number written as a decimal fraction is read as a whole number, and then given the order name of the last figure at the right. .346 is read three hundred forty-six **thousandths** (the order name of 6).

6. The decimal point in a **mixed decimal** is always read **and.** 3.4 is read three and 4 tenths.

Read today, try again tomorrow.

	a	b	c	d	e	f
1.	.1	.01	.001	0.01	3.002	50.05
2.	3.5	6.8	900.	90.	.056	34.75
3.	.084	8.4	0.84	.840	584.	5.84
4.	.5	50.	5.0	.50	6.70	6.07
5.	7.	84.	.67	6.7	5.05	.505
6.	.3	.33	3.3	.03	111.	.111
7.	.9	.99	9.9	.09	9.56	56.9
8.	.304	.009	.900	3.04	.081	.002

9. 5.28 mi.; .528 mi.; 5280 mi.; 52.8 mi.

10. \$3.146; \$33.256; \$5005.254; \$0.256; \$80.008.

11. 5284.36 sq. mi.; 8,768,594.324 sq. mi.

Writing Decimal Fractions

Directions.

1. Find out how many places in the decimal fraction you are to write. This is the way. Tenths has 1 place (because there is one zero in 10); hundredths has 2 places (because there are two zeros in 100); thousandths has 3 places (because there are 3 zeros in 1000); etc.

2. Write the decimal point first.

3. Write from left to right.

Write the following as decimal fractions in columns, making one column for each line. Keep the decimal points under each other. Why?

1. $\frac{3}{10}$, $\frac{8}{10}$, $\frac{48}{100}$, $\frac{68}{100}$, $\frac{9}{10}$, $\frac{784}{1000}$, $\frac{909}{1000}$.

2. $\frac{854}{1000}$, $\frac{63}{100}$, $\frac{5}{10}$, $\frac{12}{100}$, $\frac{96}{1000}$, $\frac{8}{100}$, $\frac{5}{100}$.

3. $\frac{8}{1000}$, $\frac{7}{100}$, $\frac{6}{10}$, $\frac{9}{1000}$, $\frac{54}{1000}$, $\frac{16}{1000}$, $\frac{15}{100}$.

4. $3\frac{8}{10}$, $5\frac{8}{100}$, $12\frac{18}{1000}$, $16\frac{8}{1000}$, $24\frac{25}{100}$, $84\frac{1}{1000}$.

5. $75\frac{8}{10}$, $\frac{75}{100}$, $\frac{75}{1000}$, $\frac{75}{10}$, $\frac{15}{1000}$, $52\frac{34}{1000}$, $35\frac{19}{100}$.

If you have written the above numbers properly, you have 5 columns which can be added. Try it.

How does column 3 differ from column 4?

How does column 1 differ from column 3?

How does column 2 differ from column 5?

Writing More Decimal Fractions

I. Answer these questions for each number before trying to write it.

1. Is the number an integer, a mixed decimal, or a decimal fraction?

2. How many places are there on each side of the decimal point?

II. Write in figures.

1. One hundred twenty-five **thousandths.**

2. One hundred and twenty-five **thousandths.**

3. Seven thousand; seven **thousandths.**

4. Twenty-five hundred; twenty-five **hundredths.**

5. Two hundred and forty-five **hundredths.**

6. 38 **ten-thousandths;** 38 **hundredths;** 38 **tenths.**

7. One hundred twenty-eight thousand six and 128 **thousandths.**

8. Thirty and 3 **thousandths;** 300 and three hundred **thousandths.**

9. Twenty and **twenty hundredths;** 20 and two **tenths.** What is the difference between twenty-hundredths and two tenths?

10. 75 **tenths;** 750 **hundredths;** 7500 **thousandths.**

The Effect of Zeros to the Right of the Last Digit in a Decimal Fraction

1. Compare $\frac{3}{4}$ and $\frac{6}{8}$ (1) as to value, (2) as to number of units, (3) as to size of units.

2. How did you change $\frac{6}{8}$ to $\frac{3}{4}$?

3. Compare .3 and .30 (1) as to value, (2) as to number of units, (3) as to size of units.

4. .30 is changed to .3 by dividing both the numerator (30) and the denominator (100) by 10. A short method of doing this is to omit the zero in .30 and write .3.

5. What was done in No. 4 is an example of changing decimal fractions with small units into decimal fractions with large units (lower terms).

6. Express the following in larger units:

.40 .260 .580 .030 .420 .60 .70 .070 .010.

7. All results in decimal operations should at once be expressed in larger units for the sake of economy.

Thus: $1.25+1.75=3$, not 3.00;

and $6.54-2.34=4.2$, not 4.20;

and $4\times.35=1.4$, not 1.40.

Judging Values

Place the decimal point so as to make the statement appear reasonable.

1. An aviator flew 91245 mi. in one hour.

2. A sixth grade boy weighed 10125 lb.

3. A sixth grade girl can run 100 yd. in 156 sec.

4. A 22450 lb. hog was sold at $1460 per 100 lb.

5. An express train ran 524 mi. in one hour.

6. A boy said, "Father sold wheat today at $225 per bu."

Judging Tenths, Hundredths, and Thousandths

1. 32 rods = ? tenths of a mile?

2. Is 3.2 rods .1 mi. or .01 mi.? How do you know?

3. Is the length of your schoolroom nearly .01 mile or nearly .001 mi. or nearly .1 mi.?

4. 172.8 cu. in. = ___cu. ft.? 17.28 cu. in = ___cu. ft.?

5. An acre contains 160 square rods. 16 sq. rd. = what part of an acre? 1.6 sq. rod. = what part of an acre?

How many tenths of an acre are there in 32 sq. rd.? in 64 sq. rd.? in 128 sq. rd.?

6. A bushel contains 2150.42 cu. in. What part of a bushel are 215.042 cu. in.? 21.5042 cu. in.?

7. Is .3 yd. more or less than 1 ft.?

8. How many inches in 30 tenths inches?

9. Which is greater, $.01 or .1 dime? .1 cent or .1 mill?

10. Are 20 lb. equal to .1 ton or .001 ton or .01 ton?

11. 3 cu. in. are a little more than_____gallon.

12. If ribbon is worth 15¢ a yard, which would you rather have, .1 of 528 ft. or .01 of a mile?

13. Is 1 inch more or less than .1 ft.?

14. Draw on the board .5 ft., .5 yd., .1 rod, .001 mile.

15. Does a letter which can be mailed for 2¢ weigh about .1 lb. or .01 lb.?

16. A poor woman had 20 lb. of coal in a basket. Was this .1 ton or .001 ton or .01 ton?

17. Name something that is worth about $.1; $.01; .1 cent; $.5; $.50; $.3.

18. It takes Mary 5 min. to walk to school. Is this about .01 hr.? or about .1 hr.? or about .001 hr.?

Addition

1. Read the sum. Where does the decimal point go in the sum?

a	b	c	d	e	f	g
3.56	5.84	2.21	4.1 yd.	1.6 in.	\$7.8	6.42 mi.
.25	.06	3.25	5.9	2.5	2.3	2.52

HINT.—In (b) say 5.9, not 5.90; in (d) say 10 yd., not 10.0 yd.

2. Find the sum. Why do you keep the decimal points in a column when you write addends under each other?

a	b	c	d	e	f
34.6	634.9	100.56	54.32	63.082	96.79
5.96	15.09	92.04	6.58	.468	140.2
13.84	396.42	104.4	1.19	4.35	58.01

3. Read as dollars and parts of a dollar. Write in a column, then add.
\$14.08; \$.084; \$64.928; \$13.072; \$.96; \$48.63; \$4.86; \$22.01.

4. Add without rewriting. What care must be taken?
(*a*) \$3.40 + \$2.56 + \$8.92 + \$2.25 + \$6.84 + \$3.56 = ?
(*b*) 2.19 mi. + 4.084 mi. + 6.4 mi. + 3.016 mi. = ?
(*c*) 221.02 acres + 384.1 acres + 165.28 acres = ?

5. Why is it desirable to have ability to add without rewriting as in example 4?

6. From New Orleans to Houston, Tex., over the Sunset Route, is 362.4 mi.; from Houston to San Antonio, via Edna, is 141.5 mi.; from San Antonio to El Paso is 619.3 mi. How far is it from New Orleans to El Paso?

7. A man bought 4 loads of coal weighing as follows: 2.06 tons; 3.74 tons; 3.012 tons; and 3.56 tons. Find the total weight.

8. The sides of a small field are 146.82 ft., 245.85 ft., 150.16 ft., and 243.46 ft. Find the distance around it.

9. The St. Louis weather report gives the following rainfall for 5 months in 1918: May, 3.28 in.; June, 1.47 in.; July, .060 in.; August, 5.26 in.; September, 5.09 in. What was the total rainfall for the five months? What was the difference in rainfall between the driest and the wettest month?

10. A boy rode on his bicycle 24.8 mi. on Tuesday, 35.5 mi. on Thursday, and 19.4 mi. on Friday. How far did he ride in the three days?

Adding Line Totals and Column Totals

	a	b	c	d	e	f
1.	$1.25+	$3.70+	$4.56+	$5.01+	$6.23=	$?
2.	2.05+	6.84+	5.34+	6.70+	3.09=	?
3.	8.92+	9.50+	3.12+	6.85+	2.30=	?
4.	4.18+	6.62+	8.90+	6.22+	4.75=	?
5.	$? +	$? +	$? +	$? +	$? =	$?

1. Without rewriting, find the sum of each of the four lines. Such a sum is called an extension total.

2. Find the sum of columns (*a*), (*b*), (*c*), (*d*), (*e*).

3. Find the sum of the sums in column (*f*).

4. Find the sum of the sums in line 5.

5. If your work is right, the sum of column (*f*) must equal the sum of line 5. Why?

6. For a use of this type of addition see the next page.

The Daily Sales Account

The following table shows the daily sales of certain departments of a large store for a week. Read it carefully to see how it is made.

Dept.	Candy	Carpet	Drug	Hat	Notions	Shoe	Total
Mon.	$75.20	$325.40	$85.60	$150.60	$120.00	$312.40	?
Tues.	50.00	450.25	75.40	250.25	175.25	325.15	?
Wed.	49.20	520.50	61.75	214.85	98.95	485.60	?
Thurs.	60.75	675.25	52.85	342.60	80.50	516.20	?
Fri.	90.50	715.50	82.60	420.90	110.15	380.40	?
Sat.	95.55	835.20	90.40	725.60	210.05	840.90	?
Total	?	?	?	?	?	?	?

1. Find the total sales of each department for the week.

2. Find the total sales of all departments for each day.

3. Find the sum of the sums in the total column. What does this sum show?

4. Find the sum of the sums in the line total, also called extension total. What does this sum show? Compare it with the sum found in No. 3.

5. Bookkeepers use this method to check the correctness of a page of work before beginning a new page. Do you see how?

6. Write in good English a sentence stating how a bookkeeper may know if a completed page, such as this, is correct.

7. May he use this method of checking before the page is complete? Try it in the above problem by considering Monday's and Tuesday's sales part of a page.

1. Name the difference.

a	b	c	d	e	f	g
3.4	.96	.52	.75	1.00	2.00	.73
−1.2	−.42	−.07	−.25	−.33	−1.25	−.25

2. Write the difference.

a	b	c	d	e
20.34	30.	2.004	1.071	6.
−17.69	−19.85	1.586	−.298	−.199

3. Find the difference without rewriting: (*a*) 18.2 − 16.1 = ? (*b*) 15.5 − 10.7 = ? (*c*) 9.2 − 7.8 = ? (*d*) 16.3 yd. − 14.9 yd. = ? (*e*) 4.5 gal. − 4 qt. = ? (*f*) 3.7 qt. − 1 pt. = ?

4. The cyclometer on a man's automobile before beginning a trip stood at 3964.8. At the close of the trip it stood at 4128.2. How long was the trip in miles?

Cyclometer

5. From Cincinnati, O. to Pittsburg, Pa. via the Pennsylvania Railroad is 310.6 mi. From Cincinnati to Columbus, O. is 119.7 mi. How far is it from Columbus to Pittsburg?

6. When the English shilling was worth \$.2434 and the French franc was worth \$.193, how much more value was there in our quarter than in each of these coins?

7. After a boy had made 29.3 mi. of a 50-mile journey the first day, how far had he still to go?

8. A man planted 60 acres in wheat, oats, and corn. He put 19.8 acres in wheat and 17.5 acres in corn. How many acres were planted in oats?

A Suburban Railroad Time Table

Miles		Stations	Hr. Min. A.M.
.0	Lv.	St. Louis	6 38
3.3	Lv.	Tower Grove	6 47
6.7	Lv.	Gratiot	6 54
7.1	Lv.	Lindenwood	6 56
7.9	Lv.	Shrewsbury	6 59
8.7	Lv.	Old Orchard	7 01
9.4	Lv.	South Webster	7 04
10.1	Lv.	Webster Groves	7 06
11.0	Lv.	Glendale	7 09
11.5	Lv.	Oakland	7 11
11.8	Lv.	Fair Lawn	7 12
12.7	Lv.	Kirkwood	7 14
13.2	Lv.	Windsor Sprgs.	7 30
14.8	Lv.	Meramec H'lds.	7 33
16.5	Lv.	Keyes Summit	7 37
17.9	Lv.	Valley Park	7 40

1. Read this table as follows: From St. Louis to Tower Grove is 3.3 mi. From St. Louis to Old Orchard is 8.7 mi. From Glendale to Oakland is .5 mi. (11.5 − 11.). From Kirkwood to Valley Park is 5.2 mi. (17.9 − 12.7); etc.

2. Which station is almost 18 mi. from St. Louis?

3. Which station is exactly 11 mi. from St. Louis? Which station is exactly .8 mi. from Shrewsbury?

4. Find the distance between

(*a*) Fair Lawn and Valley Park.

(*b*) Old Orchard and Windsor Springs.

(*c*) Tower Grove and Windsor Springs.

(*d*) South Webster and Glendale.

5. How long does it take to make the trip from St. Louis to Valley Park? How long from Old Orchard to Valley Park?

NOTE.—Get old local time tables and use them in your work as shown above.

Multiplying a Number by 10, 100, or 1000 by Moving the Decimal Point

A	B
1. 1 mill =.1 cent	1. 10 mills =1 cent
2. 1 cent =.1 dime	2. 10 cents =1 dime
3. 1 dime=\$.1	3. 10 dimes=\$1
4. 52.80 ft.=.01 mi.	4. 5280 ft.=1 mi.
5. \$.01=1 cent	5. \$1=100 cents
6. .01 ton=20 lb.	6. 1 ton=2000 lb.

1. What was done with the decimal point* in equations 1, 2, 3 of column A to get equations 1, 2, 3 of column B?

2. Answer the same question for equations 4, 5, 6 in columns A and B.

3. What was the effect of moving the decimal point in each equation of column A?

4. Moving the decimal point one, two, or three places to the right multiplies the number by 10, ___, or ___.

1. Multiply each of the following by 10, then by 100, then by 1000 by moving the decimal point the right number of places in the proper direction. Write the products.

2.48 .348 2.5 ft. .064 58 72 .072 \$.01

2. Copy these lines supplying the missing numbers.

.001 mi.=5.280 ft.	3.04 × 10=____.
.01 mi.=____ ft.	3.046 × 100=____.
.1 mi.=____ ft.	.507 × 1000=____.
1 mi.=____ ft.	.07 × 10=____.
10 mi.=____ ft.	.070 × 10=____.
100 mi.=____ ft.	1.00 × 100=____.

* The decimal point after decimal integers is usually not expressed but understood.

Dividing a Number by 10, 100, or 1000 by Moving the Decimal Point

A	B
1. $.1 = 10¢	1. $.01 = 1 cent
2. $.1 = 1 dime	2. $.01 = .1 dime
3. $.01 = .1 dime	3. $.001 = .01 dime
4. 5280 ft. = 1 mi.	4. 5.280 ft. = .001 mi.
5. 200 lb. = .1 ton	5. 2 lb. = .001 ton
6. 52.80 ft. = .01 mi.	6. .5280 ft. = .0001 mi.

1. What was done with the decimal point in equations 1, 2, 3 of column A to get equations 1, 2, 3 of column B? Remember that the decimal point after integers is often understood.

2. Answer the same question for equations 4, 5, 6 in columns A and B.

3. What was the effect of moving the decimal point in each equation of column A?

4. Moving the decimal point one, two, or three places to the left divides the number by 10, ____, or 1000.

1. Divide each of the following by 10, then by 100, then by 1000 by moving the decimal the right number of places in the proper direction. Write the quotients.

34.6	84.64 sq. mi.	$937	5464.8	196.4	2486 lb.
85.74	63360 in.	5280 ft.	876.3	248.96	

2. Copy these lines supplying the missing numbers.

10. tons = ____lb.	3486 mi. ÷ 100 = ____.
1. ton = ____lb.	37896 ÷ 100 = ____.
.1 ton = ____lb.	$896.4 ÷ 1000 = ____.
.01 ton = ____lb.	7843 ÷ 1000 = ____.

Multiplying a Decimal by an Integer

1. What does $4 \times \$2$ mean?

2. What does $4 \times .2$ mean?

3.	**4.**	**5.**	**6.**	**7.**	**8.**
2 ft.	2 yd.	2 tenths	.2	2 hundredths	.02
×4	×4	×4	×4	×4	×4
?	?	?	?	?	?

9. (*a*) $6 \times .02 = ?$ (*b*) $4 \times .15 = ?$ (*c*) $5 \times .019 = ?$

10. Multiply .084 ft. ×24.

Process.

$$\begin{array}{r} .084 \text{ ft.} \\ \times 24 \\ \hline 1.68 \\ .336 \\ \hline 2.016 \text{ ft.} \end{array}$$

If you wish to estimate the result, first multiply by 20.

$20 \times .084$ ft. $= 1.68$ ft.

$4 \times .084$ ft. $= .336$ ft.

Compare the number of decimal places in the product with those in the multiplicand.

	a	b	c	d	e	f
11.	3.26	.42	.034	8.5	7.342	6.58
	×75	×26	×56	×25	×52	×45

12. Without multiplying, how can you find the value of 12×5.28 ft.?

13. A man bought 64 acres of unimproved land at \$72.75 an acre. What was the cost?

14. Find the cost of 18 spools of thread @ \$.06¼ each.

15. In a certain city the rain fall for August, 1918, was 5.26 in. How many cubic inches of water fell on a back-yard garden whose area is 800 sq. ft.? How many gallons?

Multiplying an Integer by a Decimal

1. What is the meaning of $\frac{3}{4}$ of 8 in.? Of $\frac{9}{10}$ of 20 ft.? Of .9 of 20 ft.?

2. If $\frac{9}{10}$ of 20 ft. and .9 of 20 ft. have the same meaning, then the thinking used in the solution is the same; namely, $9 \times .1$ of 20 ft. $= 9 \times 2$ ft. or 18 ft.

3. $.3 \times 12 = ?$ Think, "$3 \times .1$ of $12 = 3 \times 1.2$." Say or write 3.6.

4. Using the method suggested in the previous example, write these products.

	a	b	c
(1)	$.2 \times 5$ ft. =	$.3 \times 8$ ft. =	$.7 \times 6$ ft. =
(2)	$.8 \times 10$ in. =	$.5 \times 6$ in. =	$.9 \times 8$ in. =
(3)	$.7 \times 7 =$	$.6 \times 6 =$	$.5 \times 5 =$
(4)	$.9 \times 40$¢ =	$.4 \times 15$¢ =	$.7 \times 70$¢ =
(5)	$.3 \times 2$ yd. =	$.8 \times 3$ yd. =	$.2 \times 2$ yd. =

5. The numbers in the last three columns were given by pupils as the products for the factors in the first. Select the right one by estimating the probable result.

	a	b	c	d
(1)	$.3 \times 78$	2.34	234	23.4
(2)	$.5 \times 84$	42	4.20	420
(3)	$.9 \times 95$	8.55	85.5	855
(4)	$.3 \times 182$	54.6	546	5.46
(5)	$.03 \times 96$	2.88	28.8	288

6. Write the answers for the following:

	a	b	c
(1)	$.04 \times 246 = ?$	$005 \times 900 = ?$	$.006 \times 2000 = ?$
(2)	$.012 \times 5280$ ft. = ?	$.064 \times \$900 = ?$	$.55 \times 784 = ?$
(3)	$.96 \times 900 = ?$	$.85 \times 324 = ?$	$.72 \times \$480 = ?$
(4)	.3 mi. = __ rd.	.2 mi. = __ rd.	.7 mi. = __ rd.

1. What is the meaning of $\frac{2}{3}\times\frac{3}{4}$ ft.? Read $\frac{2}{3}$ of, etc.

2. What is the meaning of $.3\times.9$ ft.? Does knowing the meaning of $.3\times.9$ ft. help you find $.3\times.9$ ft.?

3. $.4\times3.5$ in. $=$?

SOLUTION.—$.4\times3.5$ in. $=4\times.1$ of 3.5 in. $=4\times.35$ in. $=1.40$ in.

4. $.2\times.7=$?

SOLUTION.—$.2\times.7=2\times.1$ of $.7=2\times.07=.14$.

Using the suggestions above, find these products.

	a	b	c
(1)	$.3\times.8$ mi. $=$	$.4\times\$.9=$	$.3\times7.5=$
(2)	$.5\times9$ rd. $=$	$.6\times2.5=$	$.4\times8.5=$
(3)	$.6\times\$.84=$	$.8\times.25=$	$.7\times10.8=$
(4)	$.9\times1.5=$	$.2\times.84=$	$1.2\times45=$

Compare the number of decimal places in your product of each of the above examples with the number of places in both the multiplier and the multiplicand. Write your conclusion in a correct sentence.

Multiply 34.8 by .26.

Process

$$\begin{array}{r} 34.8 \\ \underline{.26} \\ 2.088 \\ \underline{6.96} \\ 9.048 \end{array}$$

There are 3 places in the product. Why? The product is greater than .2 of 34 (6.8) and less than .3 of 34 (10.2). Why?

Multiply 34.8 by .06. Multiply 34.8 by .2. Add the partial products.

Before multiplying one decimal by another, do these two things.

(1) Determine the number of decimal places in the product.

(2) Estimate the product by the method shown above.

Examples

Find the products.

	a	b	c
1.	3.4×6.5	$18.4 \times .56$	2.57×6.4
2.	$0.68 \times .75$	$.9 \times .76$	$.264 \times 3.5$
3.	$4 \times .96$	$.4 \times .08$	3.75×3.75
4.	$.05 \times .05$	$.25 \times .25$	8.5×85
5.	$.025 \times .25$	$.64 \times .64$	23.5×25
6.	$19 \times .18$	12.5×1.2	$34 \times .034$

Practical Application of Multiplication of Decimals

1. Find the weight of 18 packages each weighing .32 lb. How may you know that the weight is more than 5 lb. and less than 9 lb.?

2. What is the area of a rectangle 3.5 mi. long and 1.6 mi. wide? How may you know that the area is more than 3.5 sq. mi. and less than 7 sq. mi.?

3. A certain city lot is a rectangle 132.75 ft. long and 32.5 wide. Estimate the area; then find it accurately.

4. How many square feet did you miss in your estimate in problem 3?

5. A certain rectangular flower box is 34.5 in. long, 6 in. wide, and 6.5 in. deep. Estimate the volume in cubic feet. Find it exactly in cubic inches.

6. At $35.875 a front foot find the cost of a lot 26.5 ft. wide. Try your skill at estimating before you multiply.

7. .8 of some apples is water. How many lb. of water in a bushel of such apples weighing 50 lb.?

8. How much water in a bushel of potatoes weighing 60 lb. if .22 is solid matter? How much solid matter?

9. If peeled pumpkin is .92 water, find the amount of water in 20.5 lb. How may you know that the answer is more than 18 lb. and less than 20.5 lb.?

10. What is the total rainfall in a year for a city whose monthly average is 3.415 in.? Estimate the total. Ascertain it exactly.

11. Water weighs 62.5 lb. to the cubic foot. Learn and use this fact.

12. Find the weight of 12.5 cu. ft. of water.

13. The weight of ice is .92 that of water. Find the weight of a cubic foot of ice.

14. Find the weight of a cake of ice whose dimensions are 2 ft. by .75 ft. by 1.25 ft.

15. Wisconsin granite weighs 2.63 times as much as water. Find the weight of a rectangular block 6.5 ft. by 2 ft. by 1.5 ft.

16. Some limestone weighs 2.76 times as much as water. Find the weight of a block whose volume is a cubic yard.

17. Silver weighs 10.5 times as much as water. Find the weight of a little block .66 ft. long, .25 ft. wide, and .16 ft. thick.

18. Do you see why it is important to remember the weight of a cubic foot of water?

19. The thickness of a sheet of paper in this book is about .004 in. How thick is the book without the covers?

20. A boy's thrift garden contains .1 acre. How many cubic inches of water fell on the garden, when the rainfall for a certain month was 2.32 in?

A Little Review in Multiplication of Fractions

1. Multiply 320 rods by each of the following: $\frac{1}{2}$; .5; $\frac{2}{5}$; .3; $\frac{3}{4}$; .4; $\frac{5}{8}$; .7; $\frac{3}{5}$; .9; $\frac{7}{8}$; .6; $\frac{1}{40}$; .2; $\frac{3}{40}$.

2. Express each of the following in rods: .1 mi.; .01 mi.; .001 mi.; $\frac{3}{4}$ mi.; $\frac{3}{40}$ mi.; $\frac{3}{400}$ mi.; .2 mi.; .3 mi.; .7 mi.; $\frac{5}{8}$ mi.; $\frac{7}{8}$ mi.; $\frac{9}{8}$ mi.; .9 mi.; .8 mi.; 1.1 mi.; $\frac{1}{16}$ mi.; $\frac{5}{32}$ mi.; $\frac{1}{6}$ mi.

3. What is .8 of 28 cu. ft.? $\frac{4}{5}$ of 75¢? $\frac{1}{2}$ of .6 of $200? .8 of .9 of $100?

An Exercise in Placing the Decimal Point

Place the decimal point where it belongs in each of the following products after writing them on another sheet. It is better to have right answers than to try many examples.

Time. 3 minutes.

1. $3.4 \times 6.5 = 2210$	**14.** $23.5 \times 2.5 = 5875$
2. $.68 \times .75 = 5100$	**15.** $34 \times .034 = 1156$
3. $4 \times .96 = 384$	**16.** $88.2 \times .81 = 71442$
4. $.04 \times 9.6 = 384$	**17.** $3.45 \times .09 = 3105$
5. $.025 \times .25 = 625$	**18.** $.03 \times 500 = 1500$
6. $.4 \times .88 = 352$	**19.** $3004 \times .004 = 12016$
7. $.07 \times .008 = 56$	**20.** $3.1416 \times 40 = 1256640$
8. $64 \times .64 = 4096$	**21.** $.26 \times 3.75 = 9750$
9. $12.5 \times 125 = 15625$	**22.** $.01 \times .001 = 1$
10. $13.5 \times 1.35 = 18225$	**23.** $100 \times .0001 = 100$
11. $75 \times 75 = 5625$	**24.** $.002 \times 2000 = 4000$
12. $.65 \times 65 = 4225$	**25.** $.002 \times .005 = 10$
13. $6.5 \times .650 = 42250$	**26.** $.016 \times 1.6 = 256$

I. When the Divisor is an Integer

Heretofore when you divided a number with a decimal point by a whole number, you placed the decimal point in the quotient directly over the decimal point in the dividend. This plan should be followed in all examples in which the divisor is an integer and the dividend has a decimal point.

Place the decimal point in the quotient before you begin to divide.

	a	b	c	d
1.	$4\overline{)\$34.24}$	$6\overline{)\$84.96}$	$7\overline{)\$14.91}$	$8\overline{)\$.96}$
2.	$5\overline{)8.45\text{ yd.}}$	$3\overline{)96.24\text{ ft.}}$	$6\overline{)72.78\text{ in.}}$	$8\overline{).48\text{ gal.}}$
3.	$4\overline{)1.44}$	$9\overline{)8.118}$	$7\overline{)6.44}$	$5\overline{).945}$
4.	$24\overline{)2.16}$	$25\overline{)17.5}$	$16\overline{)25.6}$	$42\overline{)25.2}$
5.	$36\overline{)3.24}$	$9\overline{).0108}$	$17\overline{).34}$	$18\overline{)1.44}$

Use long division for the following wherever necessary.

Place the decimal point in the quotient before you begin to divide. Why?

Do not carry any decimal quotient beyond thousandths unless the problem asks for it.

If there is a remainder after the last division, indicate this fact by placing a + after the last quotient figure.

1. $84.72 \div 12 = ?$
2. $96.92 \div 14 = ?$
3. $4.075 \div 25 = ?$
4. $6.25 \div 25 = ?$
5. $348.4 \div 144 = ?$
6. $8467.87 \div 1728 = ?$
7. $15.375 \div 200 = ?$
8. $8464.9 \div 2000 = ?$
9. $364.8 \div 27 = ?$
10. $95.78 \div 32 = ?$
11. $6483 \div 128 = ?$
12. $4896 \div 1728 = ?$

Everyday Problems

1. If 18 tons of coal are worth $110, how much is that per ton?

2. A pile of wood is 16.5 ft. long, 7 ft. high, and 5 ft. wide. How much is the wood worth at $4.50 per cord?

3. A train traveled from El Paso, Texas, to Tucson, Arizona, distance 312.5 miles, in 9 hours. What was the average rate of speed?

4. The following was the rainfall in St. Louis for five consecutive days in August, 1918: .74 in.; .19 in.; .13 in.; 0 in.; .13 in. What was the average?

5. The rainfall in a large city for May, June, July, 1918, was 3.28 in.; 1.47 in., and .60 in. What was the average for these months?

HINT.—Carry the quotient to three decimal places instead of writing the remainder over the divisor. Treat all similar cases in this manner.

6. How many cubic yards of earth in an excavation 18.5 ft. long, 14.5 ft. wide, and 4.16 ft. deep?

7. Find the cost of 812 feet of lumber at $45 per thousand.

8. What is the cost of gasoline per mile when an automobile runs 14 miles on a gallon costing 20.25¢?

9. When gas sells at 90¢ a thousand cubic feet, what is the price per cu. ft.?

10. A box contains 144 pens. What is the price per pen if the box is sold for $.87?

11. How many tons of coal in a bin 9.6 ft. long, 7.5 ft. wide, 5.7 ft. high? Count 38 cu. ft. to a ton.

II. When the Divisor is a Decimal Fraction

1. State how you multiplied a decimal by 10, by 100, by 1000.

2. In .065, move the decimal point one place to the right and read the result; two places to the right; three places to the right.

3. Select those examples which you can solve from the following: (*a*) $4.8 \div 4 = ?$ (*b*) $4.8 \div .04 = ?$ (*c*) $7.2 \div 6 = ?$ (*d*) $7.2 \div .06 = ?$

4. Why could you not divide 7.2 by .06? Could you if the divisor were an integer?

5. Such examples as $.2 \div .02$, and $4.5 \div .9$ can be changed into examples like these, $20 \div 2$ and $45 \div 9$, without changing the value of the quotient, by multiplying both dividend and divisor by a number which will make the divisor an integer.

6. What multiplier was used to make each of the following divisors an integer? (a) $.2\overline{).6} = 2\overline{)6}$ (b) $.3\overline{)4.5} = 3\overline{)45}$ (c) $4.5\overline{)90} = 45\overline{)900}$ (d) $.17\overline{).034} = 17\overline{)3.4}$ (e) $2.5\overline{).25} = 25\overline{)2.5}$ (f) $.05\overline{)5.} = 5\overline{)500}$ (g) $.012\overline{)14.4} = 12\overline{)14400}$

7. Show by examples in integers that you do not change the value of the quotient when you multiply the divisor and the dividend by the same number.

8. By moving the decimal point, multiply **both** the **dividend** and **divisor** by a number such as 10, 100, etc., that will make the divisor an integer. Then write the quotient.

$.5\overline{).05}$	$.6\overline{)2.4}$	$1.4\overline{)84}$	$.1\overline{)10}$	$.01\overline{).1}$	$3.4\overline{)6.8}$
$16 \div .2$	$.033 \div .3$	$.24 \div 6$	$7.2 \div .002$	$18 \div .09$	

Examples

1. Divide 9.64 by .4

Process A.

$$.4\overline{)9.64} = 4\overline{)96.4}^{\;24.1}$$

or

Process B.

$$\text{'}4.\overline{)9\text{'}6.4}^{\;24.1}$$

Proof.

$4 \times 24.1 = 96.4$ or

$.4 \times 24.1 = 9.64$

In both methods the divisor is made an integer by multiplying both dividend and divisor by 10. Process B is more economical in that the example is not restated. The decimal points of the original example are shown by small marks. This retains the form of the original example, which is valuable when the work is checked.

2. Divide 29.6 by .04.

$\text{'}04.\overline{)29\text{'}60}$ Since there are two decimal places in the divisor, you must multiply both divisor and dividend by 100 as shown in the solution. Place the decimal point in the quotient before dividing. Do you see why? Finish the solution.

3. Divide .0348 by .004.

$\text{'}004.\overline{)\text{'}034.8}$ Since there are three decimal places in the divisor you must multiply both __ and __ by __.

Steps in Division of Decimals

1. Change the divisor to an integer by multiplying both divisor and dividend by 10, 100 or 1000, etc.

2. Next place the decimal point in the quotient before dividing. Divide as in integers.

3. Check your work by multiplying the quotient by the original divisor. The product obtained must equal the dividend given in the example.

Divide and check.

4. $.82 \div .2 =$
5. $6.3 \div .3 =$
6. $.01 \div .1 =$
7. $.72 \div .12 =$
8. $6.4 \div .8 =$
9. $14.4 \div 1.2 =$
10. $1.44 \div .12 =$
11. $.144 \div .12 =$
12. $.144 \div .012 =$
13. $.004 \div .02 =$
14. $.0624 \div .08 =$
15. $12.5 \div .5 =$
16. $.125 \div .05 =$
17. $1.25 \div .05 =$
18. $17.28 \div 14.4 =$
19. $172.8 \div 14.4 =$
20. $1.728 \div .144 =$
21. $.741 \div .13 =$
22. $24 \div .4 =$
23. $36 \div .9 =$
24. $12 \div .02 =$
25. $10 \div .1 =$
26. $10 \div .01 =$
27. $36 \div .002 =$
28. $15 \div .05 =$
29. $64 \div .08 =$
30. $72 \div .02 =$
31. $351 \div .27 =$
32. $140 \div 6.25 =$
33. $27 \div .375 =$
34. $4.8 \div 18.75 =$
35. $.8 \div .25 =$
36. $10 \div .001 =$
37. $.01 \div .001 =$
38. $.001 \div .01 =$
39. $22.2 \div 2.22 =$
40. $10.8 \div .12 =$
41. $1080 \div 1.2 =$
42. $1.08 \div 12 =$
43. $.64 \div 8 =$
44. $.85 \div .17 =$
45. $.85 \div 17 =$
46. $.025 \div 25 =$
47. $.025 \div .025 =$
48. $.025 \div 2.5 =$
49. $555 \div 37 =$
50. $555 \div .37 =$
51. $55.5 \div 3.7 =$
52. $5.5 \div 3.7 =$
53. $100 \div 1000 =$
54. $28 \div 56 =$
55. $12 \div 16 =$
56. $96 \div 128 =$
57. $108 \div 144 =$
58. $2.5 \div 25 =$
59. $.034 \div 170 =$

Exercises in Placing the Decimal Point in the Quotient

(Time. 5 minutes for each exercise)

I

What is the correct quotient for each of the following? Place the point, then state the result.

Write your result only on a separate paper.

The correct quotient for $275\overline{)75625}$ is 275.

1. $27.5\overline{)756.25}$	**6.** $27.5\overline{)7.5625}$	**11.** $27.5\overline{).75625}$
2. $275\overline{)756.25}$	**7.** $275.\overline{)7562.5}$	**12.** $275\overline{)75.625}$
3. $2.75\overline{)75.625}$	**8.** $2.75\overline{)75625}$	**13.** $2.75\overline{)756.25}$
4. $.275\overline{)7.5625}$	**9.** $.275\overline{)756.25}$	**14.** $.275\overline{)75.625}$
5. $275\overline{)7.5625}$	**10.** $27.5\overline{)75625}$	**15.** $2.75\overline{)7.5625}$

II

Place the decimal point where it should be in each of these quotients. It is better to have right answers than to try many examples. Write quotients only.

1. $\begin{array}{r}1\\12\overline{).12}\end{array}$	**2.** $\begin{array}{r}1\\.1\overline{)10}\end{array}$	**3.** $\begin{array}{r}2\\1.2\overline{)2.4}\end{array}$	**4.** $\begin{array}{r}5\\.24\overline{).120}\end{array}$
5. $\begin{array}{r}2\\.25\overline{)50}\end{array}$	**6.** $\begin{array}{r}5\\.7\overline{)3.5}\end{array}$	**7.** $\begin{array}{r}8\\.7\overline{).56}\end{array}$	**8.** $\begin{array}{r}1\\.25\overline{).25}\end{array}$
9. $\begin{array}{r}1\\.8\overline{)8.0}\end{array}$	**10.** $\begin{array}{r}4\\.9\overline{)0.36}\end{array}$	**11.** $\begin{array}{r}1.\\.3\overline{)3}\end{array}$	**12.** $\begin{array}{r}4\\.021\overline{).84}\end{array}$
13. $\begin{array}{r}4\\81\overline{)3.24}\end{array}$	**14.** $\begin{array}{r}1\\.3\overline{).30}\end{array}$	**15.** $\begin{array}{r}5\\.005\overline{)25}\end{array}$	**16.** $\begin{array}{r}32\\.25\overline{)800}\end{array}$
17. $\begin{array}{r}85\\8.5\overline{)722.5}\end{array}$	**18.** $\begin{array}{r}4\\9\overline{).036}\end{array}$	**19.** $\begin{array}{r}82\\.4\overline{)3.28}\end{array}$	**20.** $\begin{array}{r}21\\1.9\overline{).0399}\end{array}$

1. At \$.0625 per lb., how much flour can be bought for \$1?

2. When potatoes are worth \$.032 per pound, how many lb. can be bought with a \$2 bill? Is your answer more or less than a bushel?

3. When ice is 40¢ per hundred pounds, what is the daily cost to the family that uses 150 lb. per week? Carry your answer to thousandths of a dollar.

4. The boy mentioned on page 2 of this book sold his 390 radishes for \$1.95. How much did he get for each radish?

5. Find the rate per hour of a suburban train which runs 40 mi. in $1\frac{3}{4}$ hours. (Use 1.75 for a divisor.)

6. How long will it take a train whose average speed is 45.2 mi. to go from Chicago to Boston if the distance between these cities is 1022 miles?

7. From Denver, Colo., to St. Louis, Mo., via the Burlington, is 928 mi. Find the average speed of the train which arrives at St. Louis 28.1 hours after leaving Denver.

8. The railway distance between Chicago and St. Paul, Minn., is 442 miles. Find the average speed of the train which leaves Chicago at 10:10 A. M. and arrives at St. Paul the same day at 10:55 P. M.

9. When gasoline is 20.3¢ a gallon, how far does a machine run on a penny's worth of gasoline if it uses a gallon in going 14.5 miles? How far can a man go in this machine on a dollar's worth of gasoline? How far on a pint? How far on a quart?

10. One cubic foot of water weighs 62.5 lb. How much space is occupied by 1 lb. of water?

Changing Common Fractions to Decimals

1. $1 \div 4 = \frac{1}{4}$. You may call the numerator of a fraction the dividend and the denominator the divisor. Then a common fraction is an indicated division.

2. The value of the indicated division may be found by using the method of division of decimals. Thus, $\frac{1}{4} = .25$

Process

$$\begin{array}{r} .25 \\ \frac{1}{4} = 4\overline{)1.00} \end{array}$$

Change the following to decimals.

	a	b	c	d	e	f	g
3.	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{2}{5}$	$\frac{4}{5}$	$\frac{7}{8}$
4.	$\frac{3}{5}$	$\frac{5}{8}$	$\frac{7}{16}$	$\frac{3}{16}$	$\frac{1}{5}$	$\frac{3}{40}$	$\frac{15}{16}$
5.	$\frac{13}{25}$	$\frac{27}{40}$	$\frac{9}{16}$	$\frac{15}{32}$	$\frac{11}{40}$	$\frac{15}{20}$	$\frac{7}{20}$

6. Change $\frac{5}{6}$ to a decimal.

Process

$$\begin{array}{r} .83+ \\ \frac{5}{6} = 6\overline{)5.00} \end{array}$$

When there is a prime factor other than 2 or 5 in the denominator, there is always a remainder no matter how far the division is carried. (A prime factor is a factor which has no integral divisors except itself and 1.) In such cases it is usually sufficiently accurate to carry the result to two decimal places, indicating the remainder by a plus sign after the last quotient figure. Such decimals are called incomplete.

7. Is there any difference between .66 and .66+?

Change to incomplete decimals, carrying the result to two places.

	a	b	c	d	e	f
8.	$\frac{5}{9}$	$\frac{11}{12}$	$\frac{4}{11}$	$\frac{3}{13}$	$\frac{9}{11}$	$\frac{7}{12}$
9.	$\frac{6}{7}$	$\frac{8}{17}$	$\frac{4}{9}$	$\frac{5}{12}$	$\frac{23}{24}$	$\frac{8}{9}$
10.	$\frac{14}{15}$	$\frac{17}{18}$	$\frac{1}{24}$	$\frac{1}{13}$	$\frac{1}{19}$	$\frac{1}{17}$

Changing Mixed Numbers to Decimals

Mixed numbers may be changed to mixed decimals by changing the common fraction part to a decimal and then annexing it to the whole number.

Change $7\frac{1}{4}$ to a mixed decimal. $\frac{1}{4} = .25$; then $7\frac{1}{4} = 7.25$.

Change to mixed decimals.

	a	b	c	d	e	f
1.	$6\frac{3}{4}$	$5\frac{1}{2}$	$8\frac{3}{4}$	$3\frac{5}{6}$	$8\frac{1}{4}$	$7\frac{1}{2}$
2.	$12\frac{7}{8}$	$12\frac{3}{4}$	$8\frac{5}{8}$	$3\frac{3}{5}$	$9\frac{4}{7}$	$3\frac{4}{5}$
3.	$36\frac{1}{5}$	$40\frac{7}{8}$	$6\frac{11}{12}$	$9\frac{8}{9}$	$7\frac{3}{8}$	$1\frac{2}{3}$

Expressing Ratios as Decimals

Heretofore you have written certain ratios as common fractions. Often it is more convenient to express ratios as decimals. Change these ratios to decimals not to exceed two places.

	a	b	c
1.	18 : 20 = ?	15 : 25 = ?	8 in. : 12 in. = ?
2.	25 : 60 = ?	90 : 200 = ?	9 yd. : 12 yd. = ?
3.	16 : 48 = ?	15 : 60 = ?	60¢ : 75¢ = ?
4.	36 : 24 = ?	80 : 60 = ?	15 ft. : 19.5 ft. = ?

Changing Decimals to Common Fractions

Decimals may be changed to common fractions by expressing the denominator of the decimal and reducing to largest units by removing the common factors; as, $.75 = \frac{75}{100} = \frac{3}{4}$.

Change these decimal fractions to a common fraction.

.25 .80 .125 .625 .375 .0625 .875 .3125

Practice Tests

I

See how long it will take you to write the answer for all of these examples.

Try again tomorrow.

	a	b	c
1.	$\frac{2}{3}+\frac{3}{4}=$	$\frac{5}{6}\times\$18=$	$.09+.15=$
2.	$5¢+\$1.25=$	$8\times.09$ ft. $=$	$.9\div.3=$
3.	$.4\times.5=$	8 yd. : 2 yd. $=$	$56+64=$
4.	$89-75=$	$100-49=$	$\frac{5}{6}\times\frac{3}{4}=$
5.	$.46+.35=$	$10-.84=$	$.7\times80=$
6.	$\frac{3}{4}\times60$ min. $=$	$12\times12=$	$16\times25=$
7.	$4\div.1=$	$4\div.4=$	$3:4=$
8.	$8:6=$	1 yd. : 1 ft. $=$	$8:.1=$
9.	$.8\times.8=$	$10\times1.00=$	$10\times100=$
10.	$\frac{3}{4}-\frac{5}{8}=$	$\frac{15}{16}-\frac{7}{8}=$	$2\frac{1}{2}+7\frac{1}{2}=$
11.	$8\frac{1}{2}\times8¢=$	$30\div2\frac{1}{2}=$	$248\div100=$
12.	$5.6\times100=$	$253\div10=$	$15+25=$

II

Examine the following statements or equations. For those that are right, say "True." For those that are wrong, say "False." Then change the false ones to make them true.

1. $\frac{3}{4}=\frac{6}{8}$
2. 1 yd. $=5\frac{1}{2}$ rd.
3. $\frac{1}{6}$ of $24=24\div\frac{1}{6}$
4. $12\times\frac{1}{2}=12\div2$
5. $\$\frac{3}{4}=75¢$
6. $\frac{2}{3}+\frac{3}{4}=\frac{18}{12}$
7. 1 rd. $=16\frac{1}{2}$ ft.
8. $\frac{2}{3}-\frac{5}{6}=\frac{4}{5}-\frac{5}{6}$
9. $\$\frac{5}{8}=625¢$
10. $\$\frac{3}{4}=.75¢$

III

Write answers only. Time, 5 min.

	a	b	c
1.	$75+15=?$	$4\times.25=?$	$75\div10=?$
2.	$35-19=?$	$6\times2.5=?$	$144\div12=?$
3.	$\frac{3}{4}\times24=?$	$6\times25=?$	$84\div12=?$
4.	$96\div8=?$	$10\times2.5=?$	$.84\div12=?$
5.	$100-65=?$	$37+38=?$	$75-59=?$
6.	$100-49=?$	$24+56=?$	$50-38=?$
7.	$3.4+6.6=?$	$1.2-.5=?$	$.8\times.8=?$
8.	$7\times.25=?$	$.68-.54=?$	$.06\times200=?$

IV

Supply the missing fraction.

	a	b	c
1.	$12\frac{1}{2}$¢ = \$	25¢ = \$	50¢ = \$
2.	75¢ = \$	$66\frac{2}{3}$¢ = \$	5¢ = \$
3.	$33\frac{1}{3}$¢ = \$	$62\frac{1}{2}$¢ = \$	60¢ = \$
4.	$16\frac{2}{3}$¢ = \$	$37\frac{1}{2}$¢ = \$	10¢ = \$
5.	$8\frac{1}{3}$¢ = \$	$87\frac{1}{2}$¢ = \$	20¢ = \$

V

1. Put in one column all the integers, in another all the mixed numbers, in a third all the common fractions, and in a fourth all the decimal fractions.

$\frac{1}{2}$	46	.75	$3\frac{1}{2}$	$\frac{3}{4}$	96	$14\frac{1}{4}$	.075
$9\frac{3}{4}$	.008	98	$\frac{5}{8}$	75	$12\frac{1}{2}$	$\frac{3}{8}$	$16\frac{1}{2}$

Add each column.

2. Which is greater, and how much: $.6\times\$60$ or $\frac{3}{5}\times\$50$? $\$\frac{3}{4}+\$\frac{5}{8}$ or 70¢+65¢? $2.5\times\$40$ or $40\times\$2.50$?

1. How many pounds in 1 ton? In .1 ton? In .01 ton?

2. .001 ton of sugar costs about___¢? .1 ton of coal costs about $___?

3. Two 100-lb. sacks of sugar = ___ton.

4. Tell how many seconds there are in
$\frac{1}{2}$ min. $\frac{1}{3}$ min. $\frac{1}{4}$ min. $\frac{1}{5}$ min. $\frac{3}{4}$ min. $\frac{5}{12}$ min. $\frac{3}{20}$ min.
5 min. .3 min. .2 min. .7 min. .1 min. .9 min. .6 min.

5. Compare $.6 with $.60 (1) as to value, (2) as to number of units, (3) as to size of units.

6. From January 1, 1918, to August 1, 1918, our army was supplied with more than 500,000,000 lb. of flour. How much was that per month?

7. In seven months our army used 1,612,383 cans of condensed milk. How much was that per month?

8. The rainfall for a certain city for July, 1918, was .60 in. The normal amount for this month is 3.43 in. How much is the deficiency for the month?

9. In the same city the rainfall for August, 1918, was 5.26 in. The normal for the month is 2.66 in. How much is the excess? Would you call this a wet or a very wet month?

10. Adding the actual rainfall for July and August in the above city, determine if there is an excess or a deficiency for the two months at the end of August and how much.

11. How many gallons of water must be sprinkled on a lawn 30 ft. 6 in. by 15 ft. 3 in. to make it as wet as a shower which measures .13 inch? 231 cu. in. = 1 gallon. Carry your result to two decimal places.

12. How many tons of ice are required to fill a space 18 ft. by 16 ft. by 8 ft.? Water weighs $62\frac{1}{2}$ lb. to the cubic foot, and ice is .92 as heavy as water.

13. A dealer bought 86,240 lb. of coal at \$3.60 a long ton (2240 lb.) and sold it at 35¢ per hundred pounds. Find his profit.

14. Allowing 2150.42 cu. in. to the bushel, find how many bushels there are in a rectangular bin 8 ft. 6 in. long, 6 ft. 8 in. wide, and 6 ft. 9 in. high.

15. How deep must a man make a 10-foot by 12-foot bin to hold 1000 bushels?

16. The average daily consumption in 1918 of water by a large city, population 800,000, was 104,300,000 gallons. How much is that per person per day? how much per week? how much per year of 365 days?

17. St. Louis purifies its water at a cost of \$7.37 per million gallons. How much is that per 1000 gallons?

18. At the rate found in problem 17, find the cost of purifying for one year the water used by one person in problem 16.

19. In 1918 the Taussig Open Air School divided its school garden into beds as follows: 38 beds, each 22 ft. by $4\frac{1}{2}$ ft.; 21 beds, each $19\frac{1}{2}$ ft. by $4\frac{1}{2}$ ft.; one bed, 45 ft. by 25 ft.; and one bed, 44 ft. by 33 ft. What was the area of all beds? What part of an acre was the garden? Carry your answer to 2 decimal places.

20. During the season the children of the Taussig School grew $2032\frac{3}{4}$ lb. of garden truck. At this rate, how many tons should a garden of one acre have produced?

Liberty Loan Problems

1. Find the total subscription of a city which subscribed as follows for the first four Liberty Loans: No. 1, $42,000,000; No. 2, $71,584,000; No. 3, $43,000,000; No. 4, $76,856,900. If the population of this city is 800,000, what is the average per capita subscription for the first four loans?

2. The quota for each Federal Reserve District in the Fourth Liberty Loan is shown in the following table.

District	Quota
St. Louis	$ 260,000,000
Minneapolis	210,000,000
Boston	500,000,000
Richmond	280,000,000
New York	1,800,000,000
Dallas	126,000,000
Cleveland	600,000,000
Chicago	870,000,000
Kansas City	260,000,000
Philadelphia	500,000,000
San Francisco	402,000,000
Atlanta	192,000,000

(*a*) Find the proposed total loan.

(*b*) How much is that per person if the population of the U. S. in 1918 was 110,000,000?

(*c*) How much is the difference between the two smallest districts? How much between the largest and the smallest? How much between the two largest?

(*d*) The total subscription was $6,993,073,250. Was this an oversubscription or an under subscription? How much?

3. The total subscription to the Second Liberty Loan was $4,617,532,300. How much greater was the subscription to the Fourth than to the Second?

4. What is the ratio to two decimal places between the total subscription to the Fourth Liberty Loan and the total quota of the same loan?

The Chipmunk

1. This chipmunk (ground squirrel) when he was caught had 28 grains of corn in one of his cheek pouches and 24 grains in the other. It is estimated that there are 80 chipmunks in a certain six-acre Ohio forest. Each makes on an average 6 trips daily to neighboring cornfields and carries on each trip the load mentioned above.

(1) How many grains of corn will they store in 3 weeks?

(2) How many ounces, if you allow 96 grains to the oz.? How many lb.?

(3) What is this corn worth at $1.50 per bu.? There are 56 lb. of shelled corn in a bu.

2. The chipmunk belongs to a group of rodents such as rabbits, gophers, and prairie dogs which destroy every year $150,000,000 worth of food and feed products. About how much is that for each person in our country?

3. In a recent year the United States Department of Agriculture estimated for that year the loss of farm products due to insect pests at $795,100,000. Counting the population at 100,000,000, find the loss per person.

4. It is estimated that it costs the potato growers in this country $2,000,000 yearly for potato bug poison (Paris green). How much does that add to the cost of a bushel of potatoes if the yearly crop is 400,000,000 bu.?

CHAPTER II

PERCENTAGE

1. Read the answers to the following: (*a*) $.05 \times 400 = ?$ (*b*) $.16 \times 30 = ?$ (*c*) $.10 \times \$40 = ?$ (*d*) $.25 \times \$100 = ?$

2. You may also express hundredths by the per cent sign (%). Remember that the sign % stands for hundredths and that percentage is an application of decimals. 4% means .04. 4.5% means .045 because the sign % stands for hundredths (2 places).

3. What is the meaning of 5% of 400? of 16% of 30? of 10% of $40? Of 25% of $100?

4. Find 5% of 400, 16% of 30, 10% of $40, 25% of $100.

5. Find 8% of 300 acres, 40% of 120 ft., 3% of 200 eggs.

6. Sarah said she made 80% on a spelling test containing 100 words. What did she mean?

7. What is a girl's per cent if she solves correctly all of the problems in a list of 10? What is it if she misses 3?

8. A man said he owned 100% of a grocery business. What did he mean?

9. What is meant by "100% American?"

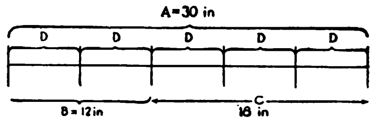
10. A boy solved 6 problems right in a set of 10. What is his mark in %?

11. John had 20 apples. 10% of them were bad, how many were good?

12. A man's weekly pay envelope contained $50. After paying 30% of it for a month's rent, how much remained?

13. If 2% of my money is $10, how much is 4% of it?

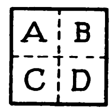
Expressing Parts of Lines and Surfaces as Per Cents



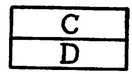
1. What part is line D of line A? of B? of C?

What % is D of A? What % is B of C?

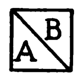
What % is C of A? What % is B of A?



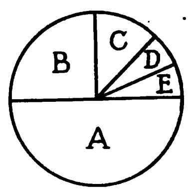
2. What % is A of the large square? What % is A of B? What % is A of BCD? What % is the large square of A?



3. What % is C of the large oblong? What % is C of D?



4. What % is A of B? What % is B of A? What % is A of the square? The square is what % of B?



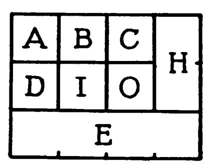
5. What % is the semi-circle A of the whole circle?

What % is the quadrant B of the whole circle?

What % is the quadrant B of A?

What % is C of B? What % is C of A? What % is C of D? What % is E of B?

6. What % is A of E? What % is A of H?



What % is A of BCDI? of BCDIO?

What % is A of the entire figure?

What % is AD of BI? What % is AD of H?

What % is AD of E? What % is H of E? H of the entire figure? E of the entire figure?

What % is H of A? H of AB? H of ABC?

Learn these facts and use them in problem solving.

1. $\frac{1}{2} = .50 = 50\%$
2. $\frac{1}{4} = .25 = 25\%$
3. $\frac{3}{4} = .75 = 75\%$
4. $\frac{1}{8} = .12\frac{1}{2} = 12\frac{1}{2}\%$
5. $\frac{3}{8} = .37\frac{1}{2} = 37\frac{1}{2}\%$
6. $\frac{5}{8} = .62\frac{1}{2} = 62\frac{1}{2}\%$
7. $\frac{7}{8} = .87\frac{1}{2} = 87\frac{1}{2}\%$
8. $\frac{1}{3} = .33\frac{1}{3} = 33\frac{1}{3}\%$
9. $\frac{2}{3} = .66\frac{2}{3} = 66\frac{2}{3}\%$
10. $\frac{1}{6} = .16\frac{2}{3} = 16\frac{2}{3}\%$
11. $\frac{1}{5} = .20 = 20\%$
12. $\frac{2}{5} = .40 = 40\%$
13. $\frac{3}{5} = .60 = 60\%$
14. $\frac{1}{10} = .10 = 10\%$
15. $\frac{7}{10} = .70 = 70\%$
16. $\frac{9}{10} = .90 = 90\%$
17. $\frac{1}{16} = .06\frac{1}{4} = 6\frac{1}{4}\%$
18. $\frac{1}{20} = .05 = 5\%$
19. $\frac{1}{25} = .04 = 4\%$
20. $\frac{1}{30} = .03\frac{1}{3} = 3\frac{1}{3}\%$
21. $\frac{1}{40} = .02\frac{1}{2} = 2\frac{1}{2}\%$
22. $\frac{1}{50} = .02 = 2\%$

Write answers only.

1. 50% of 1000 men.
2. 3% of 600.
3. 10% of 12 qt.
4. 20% of 25 sq. in.
5. $12\frac{1}{2}\%$ of \$16.
6. $87\frac{1}{2}\%$ of 24.
7. $66\frac{2}{3}\%$ of 6 gal.
8. $33\frac{1}{3}\%$ of 15 ft.
9. 60% of 60 words.
10. $37\frac{1}{2}\%$ of 32 days.
11. 40% of \$40.
12. $2\frac{1}{2}\%$ of 80.

Find 25% of \$36.

One pupil's solution.

$$\begin{array}{r} \$36 \\ \underline{.25} \\ 1.80 \\ \underline{7.2} \\ \$9.00 \end{array}$$

Another pupil's solution.

$\frac{1}{4}$ of \$36 = 9.

Which pupil has the better solution? In solving problems always use the shortest method. Why?

Examples

1. What is $33\frac{1}{3}\%$ of \$954?
2. Find 10% of 5280 ft.

3. Find 12% of \$25.
4. 25% of 16 quarts of cherries = ?
5. What is $2\frac{1}{2}$% of 80 acres?
6. Find $16\frac{2}{3}$% of 24; $33\frac{1}{3}$% of 144.
7. 50% of 80 words = ?
8. $66\frac{2}{3}$% of 18 = ? $66\frac{2}{3}$% of \$60 = ?
9. Find 75% of 60 ft. 75% of 800 mi. = ?
10. 40% of \$10 = ? $33\frac{1}{3}$% of 75¢ = ?

Written Work

Find 16% of \$125.

\$125	16% means .16.
.16	Therefore 16% of \$125 is .16 × \$125.
7.50	
12.5	
\$20.00	

Find

1. 8% of \$24.50
2. 22% of 960 bu.
3. 95% of \$105
4. 9% of 700 in.
5. 85% of \$360
6. 12% of 840 ft.
7. 27% of \$325
8. 7% of 52 mi.
9. 54% of \$225
10. 72% of \$365.50

11. Mr. Jones bought an automobile for \$1200 and a year later sold it for 85% of this price. Find the selling price.

12. John has \$12 in a savings bank, and his brother has 65% of this amount. How much have both?

13. The Wyman ball team won 60% of the series of 15 games. How many games did they lose?

14. In 1918 there were 1,602,000 families in the United States whose net annual income per family was \$1500. The Government expected each of these families to invest on the average 14.04% of its income in Liberty Bonds. What was the total investment expected of all these families? 14.04% = .1404

15. The Fourth Liberty Loan of \$6,000,000,000 was oversubscribed 14.44%. What was the total subscription?

16. The Boston Federal Reserve District's quota of the Fourth Liberty Loan was \$500,000,000. What was the entire subscription of this district, its quota being oversubscribed 26%.

17. In the Fourth Liberty Loan drive the Atlanta District reached 112% of its quota of \$192,000,000. What was the subscription?

18. The annual production of iron ore in the United States for a 5-year period was 56,000,000 tons. Of this amount Minnesota produced 60%, and Michigan produced 22%. Find the annual output in tons of each of these states. Locate the iron ore mines in these states. Estimate the annual output of all the other states combined.

19. The annual production of flaxseed in the United States is 19,500,000 bushels. North Dakota produces 42% of this amount. What is its annual production?

20. The average annual production of cotton in the United States for the five-year period ending in 1917 was 12,776,000 bales. Texas produced 29.1% of this amount, and Georgia produced 16.6%. Find the average yield in bales of these states. 29.1% = .291. Why?

The part one number is of another is called a ratio.

A ratio may be expressed as a common fraction, as a decimal, or as per cent.

Find and express each of the following ratios in 3 ways.

Thus: 2 ft. : 3 ft. $= \frac{2}{3}$, or $.66\frac{2}{3}$, or $66\frac{2}{3}\%$.

1. \$1 : \$2 =
2. 3 in. : 4 in. =
3. 3¢ : 12¢ =
4. 8 oz. : 16 oz. =
5. \$15 : \$20 =
6. 12 in. : 1 yd. =
7. 2 nickels : 1 dime =
8. 1 pk. : 2 bu. =
9. 70¢ : 80¢ =
10. 27 ft. : 30 ft. =
11. $\$\frac{1}{2}$: $\$\frac{3}{4}$ =
12. \$.1 : 40¢ =
13. \$40 : \$50 =
14. $5\frac{1}{2}$ rd. : 11 rd. =
15. 500 lb. : 1 ton =
16. 1 qt. : 1 pk. =
17. 1 qt. : 1 gal. =
18. $12\frac{1}{2}$¢ : \$1 =
19. $62\frac{1}{2}$¢ : \$1 =
20. 75 : 100 =

Finding What % One Number Is of Another

1. Find what per cent \$3 is of \$6.

This is just another way of saying, "Find what part \$3 is of \$6," or, "Find the ratio of \$3 to \$6."

2. What % is \$2 of \$100?

SOLUTION.—\$2 is $\frac{1}{50}$ of \$100. $\frac{1}{50} = 2\%$.
Therefore \$2 is 2% of \$100.

3. A boy had 10¢ and afterward lost 2¢. What % did he lose?

4. Mary earned 25¢, and then spent 5¢ of it for a tablet. What % of her earnings did she spend? What % of her earnings had she left?

5. Henry bought 12 oranges. Three of them were damaged. What % was sound?

6. James earned 80¢ shoveling snow. He spent 25% for stamps. The next day he spent 25% of what he had remaining for 3 pencils. How much had he left after buying the pencils?

7. A boy bought a sled for $1.00. The next day he sold it for $1.25. How much was his profit? What part of the cost was his profit? What was his % of profit?

8. A boy ate $\frac{1}{3}$ of a small custard pie. What % of the pie remained?

9. Frank had 16 marbles and found 4 more. What was his % of increase?

10. Mamie had 5 pennies. Afterward she lost 2. What was her % of loss?

11. James had $1.00 in a savings bank. On Saturday he added 50¢ to his account. What was his % of increase? The next Saturday he added another 50¢ piece. What was his % of increase this time?

12. What is the % of saving when a 10 cent loaf of one day old bread can be bought for 8¢?

13. On Tuesday Mary solved 4 out of 5 long arithmetic problems correctly. On Wednesday she had the right answer for 8 out of 10 short ones. On which day did she make the better mark?

14. Frank missed one word out of a spelling list of 20 words. What was his grade?

15. How many words may a pupil miss out of a list of 20 and still make 75%?

16. Roy made 3 hits in 12 times at bat. What was his batting per cent?

1. What % is $15 of $19?

Process

$$\begin{array}{r} .79-\ =79-\% \\ 19.\overline{)15.00} \\ \underline{13\ 3} \\ 1\ 70 \\ \underline{1\ 71} \end{array}$$

In problems in which the fraction is not an easy aliquot, it is best to employ at once the method of division of decimals, carrying the result to two decimal places. A minus sign after the last quotient figure is read **nearly**. When is it proper to use minus and when plus? See the next problem. $15 is nearly 79% of $19.

2. $23 is what % of $27?

Process

$$\begin{array}{r} .85+\ =85+\%. \\ 27\overline{)23.00} \\ \underline{21\ 6} \\ 1\ 40 \\ \underline{1\ 35} \end{array}$$

$23 is a little more than 85% of $27.

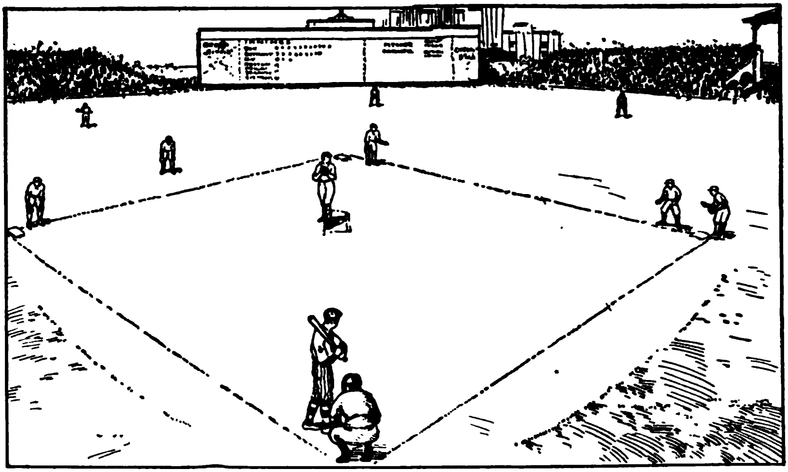
3. In 1918 a man raised 35 bushels of corn to the acre. In 1919 he raised 43 bushels to the acre. What was the %, or rate, of increase?

4. In 1914 hogs sold for 12¢ a pound. In 1918 this quality of hogs sold for 19¢ a pound. What was the % of increase?

5. At 8 A.M. on a certain day the temperature of the school room was 65 degrees Fahrenheit. One hour later it was 72 degrees. What was the % of increase?

6. At 4 P.M. the temperature of the school room was 72 degrees, at 5 P.M. it was 65 degrees. What was the % of decrease?

7. What is the % of increase if a man's weekly wage is increased from $16 to $19?



American League Standing

Club	Games Played	Won	Lost	Per Cent Won
Boston	101	61	?	.604
Cleveland	102	58	?	?
Washington	100	55	?	?
New York	97	48	?	?
Chicago	99	47	?	?
St. Louis	98	45	?	?
Detroit	100	44	?	?
Philadelphia	99	40	?	?

The above is the record of the different teams in the American League on a certain day in 1918.

1. Find the number of games lost by each team.

2. Find the standing of each team carried to three decimal places. In the newspapers the decimal point is usually omitted.

3. The standing of Boston is 604, more accurately, .604 or 60.4%. What is the meaning of this? How do you get .604?

4. If Boston lost on the next day, what would be their standing? What would it be if they won?

5. Assuming Cleveland won from New York the next day, compute the standing of each team.

6. Compute the standing of the two teams after Detroit lost to Washington.

7. If you are working on this page in baseball season, compute the standing of your favorite team for a week to see if the newspapers have it right.

8. A boy said, "If Philadelphia wins the 100th game played, it will add 6 points to its per cent column." What did he mean? How did he obtain 6 points?

9. The same boy said, "If Boston wins its 102nd game played, it will add only 4 points to its per cent column." How did he get 4 points? Why not add 6 points?

10. If Chicago lost its 100th game played, how many points must you subtract in the table you made at the beginning of this exercise? If Chicago won the 100th game, what change would you make in the per cent column?

Percentage Problems Using Large Numbers

1. The population of Dayton, Ohio, in 1910 was 116,577, and in 1920 it was 153,830. Find the % of increase.

2. From 1910 to 1920 the population of Beaumont, Texas, increased from 20,640 to 40,422. Find the % of

increase. Look at the map and then try to account for this rapid growth.

3. In the autumn of 1916 the Department of Agriculture at Washington estimated that the 1917 corn crop in the United States would be 3,191,000,000 bu. The actual crop was 3,159,494,000 bu. By what % was the estimate wrong?

4. In the autumn of 1916 the 1917 oats crop was estimated to be 1,580,000,000 bu. The actual crop was 1,587,286,000 bu. How close in % was this estimate?

5. At the same time the above estimates were made the 1917 wheat crop was estimated to be 659,797,000 bu. The actual crop was 650,828,000 bu. How nearly accurate in per cent was this estimate?

6. In 1918 there were in the United States 3,525,000 families whose annual net income was $1000 each. These families were expected to buy Liberty Bonds amounting to $418,770,000. How much was that per family? What per cent of its income was each family expected to invest in such bonds?

7. It was estimated in 1918 that a family with a net income of $6500 should buy $2300 worth of Liberty Bonds. What per cent is this of the income? If there were 36,500 such families in the United States, what was the total amount in Liberty Bonds to be bought by them?

8. If a family with a net income of $1,106,000 invested $1,008,600 in Liberty Bonds, what per cent of the income was so invested?

I

State the products. Time yourself.

1. $.03 \times 200$ ft. =
2. $6\% \times \$200 =$
3. $4\% \times 800$ mi. =
4. $5\% \times 40$ bu. =
5. $.01 \times 1728$ cu. in. =
6. $1\% \times 144$ sq. in. =
7. $.10 \times 10¢ =$
8. $10\% \times 100¢ =$
9. $\frac{1}{2}\% \times \$200 =$
10. $12\frac{1}{2}\% \times 8$ ft. =
11. $16\frac{2}{3}\% \times 84$ acres =
12. $33\frac{1}{3}\% \times \$60 =$
13. $.25 \times 60¢ =$
14. $25\% \times 20¢ =$
15. $66\frac{2}{3}\% \times 24$ bu. =
16. $25 \times 32 =$
17. $25\% \times 32 =$
18. $20\% \times 10$ in. =
19. $50\% \times \$800 =$
20. $75\% \times 80¢ =$

II

The children in the sixth grade of the Wyman School had a 3-minute test of 12 examples in fractions. Read the % each had right.

John had 12 right.
Lucy had 8 right.
Jennie had 7 right.
Helen had 9 right.
Allen had 8 right.
Lois had 6 right.
Melvin had 11 right.
James had 6 right.
Josephine had 12 right.
Jack had 8 right.
Albert had 6 right.
Jane had 7 right.
Leonard had 5 right.
Lena had 10 right.

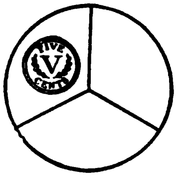
What was the average % right for the girls? For the boys?

III

Replace the dash with the proper number.

1. $2\% =$ —% of 1%
2. $.08 \div .02 =$ —
3. $3 =$ —% of 4
4. $\$10 =$ —% of $\$80$
5. $.08 : .02 =$ —
6. $.02 =$ — of $.08$

More Percentage Problems



A sixth grade boy said to his classmate, "Can you tell me how much money I have when $33\frac{1}{3}\%$ of it is a nickel?" What was the correct answer?

Show with a figure what all my money is when 25% of it is \$2.50.

If 20% of my money is \$5, find my money.

Think, "My money is $5 \times \$5$, because 100% of my money is $5 \times 20\%$ of my money." Say or write, \$25.

Find the number if

1. 10% of it is \$5

2. $12\frac{1}{2}\%$ of it is \$6

3. 2% of it is 1 ft.

4. 5% of it is 2 yd.

5. $33\frac{1}{3}\%$ of it is \$10

6. 25% of it is 10 ft.

7. 50% of it is 9

8. 20% of it is \$21

9. 4% of it is 10 gal.

10. $16\frac{2}{3}\%$ of it is 1 bu.

11. $66\frac{2}{3}\%$ of it is 2

12. 75% of it is 6

13. 30% of it is 30

14. $\frac{2}{5}$ of it is \$8

HINT.—Compare $\frac{5}{5}$ of the number with $\frac{2}{5}$ of it.

15. $\frac{4}{5}$ of it is 12 ft.

16. .4 of it is 4

17. .5 of it is $\$37\frac{1}{2}$.

18. 25% of it is $\frac{3}{4}$

19. $33\frac{1}{3}\%$ of it is $\frac{2}{3}$

20. 75% of it is 3 gal.

21. If $33\frac{1}{3}\%$ of my crop is 300 bu., what is $3\frac{1}{3}\%$ of it?

HINT.—$3\frac{1}{3}\%$ is $\frac{1}{10}$ of $33\frac{1}{3}\%$.

22. If 6% of John's money is \$10, how much is 60% of it?

23. A boy did 60% of his examples right, and 30% wrong. What % of them did he omit?

1. If 6% of a piece of land is 54 acres, what is all of it?

HINT.—Compare all of the land (100% of it) with 6% of it.

SOLUTION.—All of it $=\frac{100}{\cancel{6}}\times\overset{9}{\cancel{54}}$ acres $=900$ acres.

2. 22.5 lb. is 35% of how much?

HINT.—Compare the whole weight (100% of it) with 35% of it.

SOLUTION.—100% of the weight $=\frac{100}{\underset{7}{\cancel{35}}}\times\overset{4.5}{\cancel{22.5}}$ lb.

100% of the weight $=\frac{450}{7}$ lb. $=64\frac{2}{7}$ lb.

3. A man spent $18 for an overcoat. This was 6% of his money before he bought the coat. How much money had he after paying for the coat?

HINT.—Compare % left with 6%.

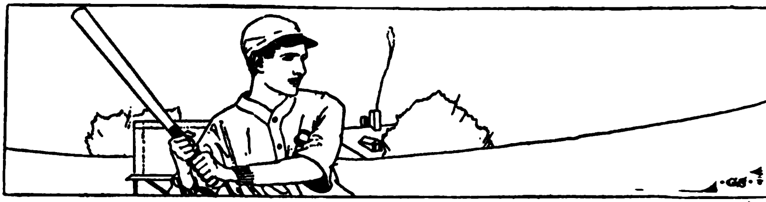
4. John drew a check for $36, which was 12% of his bank account. How much had he in bank after the check was paid?

5. A man sold a horse for $180 at a profit of $12\frac{1}{2}$% of the cost. What was the cost? What was the profit?

6. I paid Mr. B $22.65, which was 17% of what I owed him. Later he asked for 68% of the original debt. How large a check must I write in his favor?

7. I paid $278.64, which was 86% of the debt against my house. How much remained?

8. A man paid 30% of a $100-Liberty Bond. Later he paid 50% of the unpaid balance. How much remained after the second payment?



Computing Batting Averages

The following table shows the record of the six highest hitters in the American League for the season of 1918. Compute the per cent to see if the record is correct.

Player Team	At Bat	Hits	Pct.
Cobb, Detroit	421	161	.382
Griggs, Detroit	99	36	.364
Jackson, Chicago	65	23	.354
Burns, Philadelphia	505	178	.352
Fournier, New York	100	35	.350
Sisler, St. Louis	452	154	.341

1. If Cobb's batting average had been .400, how many hits would he have made?

2. How many hits would Griggs require to equal Cobb's record?

3. Suppose Fournier had made 36 hits, what would have been his position in the above table?

Find the value of the question mark in the following table, which contains the record of the five next best hitters in the 1918 American League.

Player Team	At Bat	Hits	Pct.
Beecher, Cleveland	60	?	.333
Shocker, St. Louis	34	11	?
Speaker, Cleveland	471	?	.319
Baker, New York	?	154	.306
Pipp, New York	349	?	.304

I. Sometimes merchants allow a small reduction from the bill or regular price for prompt payment. Such a reduction is called a discount.

How much would settle each of the following for cash?

1. A \$2.20 gas bill, less 10%.
2. A \$3.00 electric light bill, less 5%.
3. A \$9.50 grocery purchase, less 2%.
4. A \$25.00 suit of clothes, less 4%.
5. A dry goods bill of \$12.50, less 1%.
6. A \$140 tax bill, less $1\frac{1}{2}$%.
7. A \$2 weekly paper, less 25% if paid in advance.

II. Merchants at the end of the season often make special sales, giving large discounts, rather than carry the stock over. Find the value of the question mark in each of the following.

Commodity	Regular Price	Discount	Sale Price
Straw hats	\$2.50	40%	?
Men's shirts	2.00	?	\$1.75
Men's ties	.75	$33\frac{1}{3}$%	?
Boys' shoes	3.50	10%	?
Collars, per doz.	2.00	?	\$1.50
Boys' suits	15.00	?	10.00

III. Furniture houses sometimes make large reductions on pieces used as samples. Find the value of the question mark in each of the following items.

Commodity	Regular Price	Discount	Reduced Price
Oak rocker	\$12	?	\$ 9
Morris chair	25	20%	?
Mahogany center table	10	?	\$ 8
Sectional book case	30	?	\$20
Library table	28	25%	?

Buying or Selling for Another

1. John receives a penny for every 5¢ newspaper sold. What is his % of pay?

2. John's pay in problem 1 is called his commission, and the % you found is his rate of commission.

3. How much does he earn in a morning if he sells $6 worth of papers?

4. When a person buys or sells for another person, he is said to do a commission business, and the % of the sale or purchase he receives for his work is the rate of commission.

5. James receives $2.00 for buying and sending a $40 wheel to a friend in the country. What is his rate of commission?

6. A clerk in the hat department receives 4% commission. On a certain Saturday his sales were $125. Compute his day's wages.

7. A commission merchant sells 50 bushels of apples at 80¢ a bushel, receiving a 2% commission. How much money does he send the grower?

8. An agent receives 4% for collecting rent. How much commission does he receive in a year on a house renting at $50 per month?

9. A real estate agent sold a house and lot for $4000 at 5% commission. How much money did he send the owner?

10. How much money can a boy earn on a Saturday by selling $6.00 worth of oranges at 10% commission?

11. My agent receives 4% on all purchases made by him for me. What does this mean?

12. How much commission is received in each of the following cases?

1. 2 % on $800	4. 20% on $20	7. 3% on $700
2. $\frac{1}{2}$% on $400	5. $\frac{3}{4}$% on $800	8. 6% on $500
3. $1\frac{1}{2}$% on $200	6. 5% on $120	9. 2% on $1000

13. Can you name a transaction in which a person might get a 20% commission? One in which he might get only $\frac{1}{2}$% commission?

14. What is the difference between a rate of profit and a rate of commission?

15. What is the rate of commission in each of these?

1. $2 commission for collecting a $20 account.
   HINT.—$2 is $\frac{1}{10}$ or 10% of $20.
2. $5 for collecting a $40 debt.
3. $3 for collecting $300 rent money.
4. $20 for selling $1000 worth of land.
5. $10 for buying $500 worth of hogs.
6. $25 for selling a $1000 city lot.
7. $6 for selling $120 worth of potatoes.

16. A boy earned $4 selling fruit at 10% commission. How much did he sell?

HINT.—10% of the sale, or $\frac{1}{10}$ of it, is $4.

17. Find the amount of sale or purchase in each of the following.

Commission Received	Rate of Commission
1. $2 for collecting gas bills	5%
2. $8 for selling shoes	4%
3. $10 for selling coal	2%
4. $100 for buying a house and lot	2%
5. $2 for buying potatoes	2%
6. $150 for collecting grocery bills	5%

CHAPTER III

Exercises for Speed and Accuracy

I

In which of these sets do the three numbers have the same value?

1. $\frac{3}{4}$ .75 75%
2. \$5$\frac{1}{2}$ \$5.5 550¢
3. 1 bu. 16 qt. 4 pk.
4. 5.6 mi. 5.60 mi. $\frac{5}{35}$ mi.
5. \$$\frac{2}{3}$ 66$\frac{2}{3}$¢ \$.66$\frac{2}{3}$
6. $\frac{3}{4}$ $\frac{4}{3}$ 75
7. 1$\frac{3}{8}$ $\frac{8}{11}$ $\frac{11}{8}$
8. $\frac{1}{4}$ 25¢ .25
9. \$.001 $\frac{1}{10}$¢ 1 mill
10. 1 dime \$.1 10¢
11. \$.01 \$.10 10¢
12. .5 mi. 160 rd. $\frac{1}{2}$ mi.
13. .50 .5 50%
14. \$$\frac{2}{3}$ 65¢ \$.67
15. 1 bu. 32 qt. 4 pk.
16. 1 gal. 8 qt. 4 pt.
17. 1 yd. 36 in. 3 ft.
18. \$$\frac{1}{6}$ 16$\frac{2}{3}$¢ \$16$\frac{2}{3}$
19. 20. 20% .20
20. 18. 1.8 .18

II

Name a quick way of finding

25% of \$40
12$\frac{1}{2}$% of \$8
16$\frac{2}{3}$% of 12 ft.
$\frac{1}{2}$% of \$200
33$\frac{1}{3}$% of \$30
40% of 45
75% of 12
10% of 200
8$\frac{1}{3}$% of \$12
25 × 48

12$\frac{1}{2}$ × 24
16$\frac{2}{3}$ × 96
75 × 32
66$\frac{2}{3}$ × 18
16 @ 12$\frac{1}{2}$¢
80 @ 25¢
24 @ 8$\frac{1}{3}$¢
36 @ 16$\frac{2}{3}$¢
21 @ 33$\frac{1}{3}$¢
64 @ 75¢

9 at 3 for 20¢
1$\frac{1}{2}$ doz. @ 20¢
8 at 12 for 15¢
12 at 3 for 10¢
15 at 6 for 50¢
4 at 6 for 75¢
6 at 2 for 25¢
.01 × \$224
.001 × 5280 ft.
100 × 2.25 mi.

III

Write answers only.

1. $\frac{1}{2}+.25+33\frac{1}{3}\%=?$
2. $\frac{7}{8}+37\frac{1}{2}\%+.62\frac{1}{2}=?$
3. $\frac{5}{16}+.06\frac{1}{4}+25\%=?$
4. $\frac{1}{2}+\frac{2}{3}+\frac{3}{4}+\frac{5}{6}+\frac{11}{12}=?$
5. $87\frac{1}{2}\%+\frac{1}{8}+.50=?$
6. $66\frac{2}{3}\%+\frac{1}{3}+50\%=?$
7. $\frac{2}{3}+\frac{1}{8}+\frac{5}{12}+\frac{19}{24}=?$
8. $\frac{1}{2}+\frac{1}{4}+\frac{7}{8}+\frac{3}{16}=?$
9. $.15+.2+.45+.8=?$
10. $.66\frac{2}{3}+66\frac{2}{3}\%+\frac{2}{3}=?$
11. $\frac{7}{8}+.78\frac{1}{2}+87\frac{1}{2}\%=?$
12. $.9+.95+95\%=?$
13. $2\frac{1}{2}\%+2.5+.025=?$
14. $3\frac{1}{3}\%+.33\frac{1}{3}+.01\frac{1}{3}=?$
15. $\frac{3}{4}-.33\frac{1}{3}=?$
16. $.38-19\%=?$
17. $\frac{5}{12}-.25=?$
18. $\frac{3}{4}-75\%=?$
19. $100\%-\frac{3}{5}=?$
20. $\frac{5}{8}-\frac{13}{24}=?$
21. $\frac{15}{16}-12\frac{1}{2}\%=?$
22. $.8-80\%=?$
23. $98\%-\frac{1}{2}=?$
24. $.27-\frac{1}{4}=?$
25. $\frac{15}{24}-\frac{5}{8}=?$
26. $37\frac{1}{2}\%-\frac{3}{8}=?$
27. $\frac{3}{4}-\frac{2}{3}=?$
28. $25-25\%=?$

IV

Add, subtract, multiply. Write answers only.

24	33	28	23	21	28	42	32	33	51	61	42	43	72
6	6	7	7	9	9	5	6	7	8	9	7	8	9

81	80	62	63	39	29	48	89	79	69	58	99	91	82
8	9	7	9	6	5	7	4	3	6	6	5	7	6

V

Divide each of the following by 7, 8, 9. Name the quotient and remainder.

62 58 53 23 37 47 50 61 71 19 31 39 29

VI

Be sure to know the meaning in plain English. Then write the answer for the question mark.

1. $13+?=25$	**6.** $\frac{1}{4}+?=\frac{3}{4}$	**11.** $\frac{3}{4}+?=1\frac{1}{4}$
2. $?+8=23$	**7.** $?+\frac{2}{3}=\frac{5}{6}$	**12.** $?+8$ oz. $=1\frac{1}{2}$ lb.
3. $\frac{3}{4}+?=\frac{17}{12}$	**8.** $\frac{2}{3}+\frac{5}{8}=?$	**13.** $\frac{3}{5}+\frac{3}{10}=?$
4. $16-?=9$	**9.** $\frac{7}{8}-?=\frac{1}{2}$	**14.** $\frac{5}{12}-?=\frac{1}{12}$
5. $?-17=7$	**10.** $?-\frac{1}{2}=2\frac{1}{2}$	**15.** $?-\frac{1}{3}=\frac{1}{6}$

VII

Add as rapidly and accurately as you can. Write sums only.

1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**
3	15	126	9672	10248	525604	3.4
7	24	324	4238	12432	348920	5.6
8	82	105	8678	16845	752607	2.7
9	9	98	4590	32304	803269	4.9
6	36	256	3675	50008	940704	.8
8	78	295	4829	63789	736764	6.
4	42	592	3638	74507	313242	4.8
2	35	497	4183	42964	252813	3.9
1	99	385	3562	83624	919250	4.5

VIII

Write the differences.

1.	**2.**	**3.**	**4.**	**5.**	**6.**
7.48	804.	506.04	100.	425.	560.
2.99	29.71	297.58	25.76	358.22	499.85

IX

You will be given six minutes to work as many of these multiplication examples as possible after you have copied them on a larger sheet of paper from the teacher's dictation. A 6th grade pupil, good in multiplication, should have 8 right in 6 minutes. Some 6th grade pupils have done 14 right in 6 minutes. It is more important to have your answers right than to try a great many examples.

After the test solve those you missed and those you did not try. Check these answers by division. Business men generally check their work.

8742	2143	4079	6785	9809
360	89	57	96	42
9786	6739	4921	9524	6785
45	19	73	58	24
7568	3478	3484	3792	3098
83	92	208	57	67
5624	9389	9158	3528	6809
18	79	42	35	69

X

Replace the dash with the proper number.

1. 6% of 20 ft. = ___

2. 10% of 40 pk. = ___ bu.

3. 30% = ___% of 60%

4. 2% = ___% of 1%

5. $12\frac{1}{2}$% of $16 = ___

6. $20 = ___% of $40

7. 3 qt. = ___% of 3 gal.

8. 200% of 2 sq. in. = ___

9. 5% of 80% = ___%

10. ___ = 50% of $60

11. 8 qt. = 100% of ___

12. 150% of $10 = ___

XI

In solving a long division example time may be saved by not writing the last multiplication, if it is found that the last trial dividend contains the divisor exactly.

$$\begin{array}{r} 284 \\ 35\overline{)9940} \\ \underline{70} \\ 294 \\ \underline{280} \\ 140 \end{array}$$

In the example, $9940 \div 35 = ?$, as soon as you see that 35 is contained in 140 (the last partial dividend) exactly 4 times, the example is solved.

Find these quotients, using the suggestion above.

	a	b	c
1.	$81438 \div 98 = ?$	$19318 \div 26 = ?$	$15176 \div 28 = ?$
2.	$16907 \div 29 = ?$	$36096 \div 64 = ?$	$21170 \div 58 = ?$
3.	$14248 \div 26 = ?$	$34010 \div 38 = ?$	$16443 \div 29 = ?$
4.	$22848 \div 56 = ?$	$22940 \div 74 = ?$	$50107 \div 89 = ?$

XII

Speed Test in Division

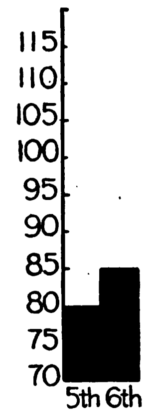
You will be given eight minutes to work as many of these division examples as possible after copying them properly on a large sheet of paper from the teacher's dictation. A 6th grade pupil, good in division, should have 8 right. Some 6th grade pupils have done 15 right in 8 minutes. It is more important to have your answers right than to try a great many examples.

After the test solve those you missed and those you did not try. Check these answers by multiplication.

	a	b	c	d
1.	$28\overline{)8204}$	$65\overline{)45825}$	$58\overline{)51736}$	$94\overline{)38634}$
2.	$47\overline{)39997}$	$36\overline{)23076}$	$74\overline{)48100}$	$25\overline{)12075}$
3.	$93\overline{)69006}$	$76\overline{)29184}$	$49\overline{)34986}$	$52\overline{)14196}$
4.	$34\overline{)31960}$	$85\overline{)29495}$	$56\overline{)45304}$	$67\overline{)28877}$

XIII

On pages 96 and 97 you will find the Fraction Test which you took a year ago. It is suggested that the class turn to this page and take the test under the conditions there described. A 6th grade pupil, good in fractions, should have 85 right in 30 minutes. Some 6th grade pupils have tried 113 and had 108 right.



1. The figure shows the position of a 5th grade pupil, good in fractions, 80 right. It also shows the position of a 6th grade pupil, good in fractions, 85 right. After the test find your position as a 6th grade pupil. Some 6th grade pupils have reached the 108 mark in 30 minutes.

2. Find from the figure the growth in fractions in per cent in one year.

3. Compare your mark in this test with that of the 6th grade pupil in No. 1 above in per cent, either as so many per cent better or so many per cent short.

XIV

Write the results without rewriting the example.

1. 84 + 65 + 38 + 52 =	**6.** 10,000 − .846 =
2. 7.8 + 3.84 + 2.9 + 5.16 =	**7.** 4000 − 2542 =
3. 356 + 105 + 72 + 280 =	**8.** 4001.5 − 299.6 =
4. \$38.74 + \$25.65 + \$13.25 =	**9.** \$38.50 − \$19.25 =
5. 3264 − 1589 =	**10.** \$3.4 − \$1.95 =

XV

Supplying the Question

Supply the question to the statement. Then solve the problem. Some of the statements permit several proper questions. Do not be satisfied with one question and one solution if there are others.

1. A boy owns a rectangular thrift garden 40 ft. long and 30 ft. wide.

QUESTION.—What is the perimeter?

SOLUTION.—Perimeter $=2\times 40$ ft. $+2\times 30$ ft. $=140$ ft.

QUESTION.—What is the area?

SOLUTION.—Area $=40\times 30$ sq. ft. $=1200$ sq. ft.

2. A man's goods cost him \$800. In selling, he lost 10% of the cost.

3. A square field is 80 rd. on each side. Fencing costs 80¢ a rod.

4. A rectangular field 80 rd. long contains 20 acres.

5. Mary missed 5 questions out of 8 in her geography test.

6. John raised 60 bushels of potatoes. He sold $\frac{1}{2}$ at \$1.50 a bushel and gave his father $\frac{1}{3}$ of the remainder for the use of the ground.

7. A man bought $6\frac{1}{2}$ tons of hay at \$22 per ton.

8. A real estate agent bought a house and lot for \$4750. Six months later he sold it for \$5000.

9. A grocer bought a box of 64 grape fruit for \$1.75. 3 were bad. He sold the rest at 5¢ each.

10. Frank tried 8 examples in an arithmetic test and had 7 right.

XVI

Read the answer without help of pencil.

1. 4 gallons of gasoline at $20\frac{1}{2}$¢ cost how much?

2. What is the cost per gallon at 5 gal. for $1.10?

3. What will a 5-lb. hen cost at 27¢ per lb.?

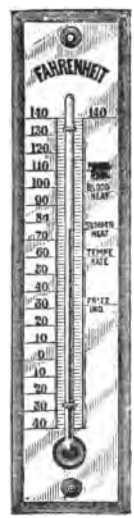
4. A 12-lb. turkey cost $4.20 in 1918. Find the cost per lb.

5. Find the cost of 9 boxes of berries at 3 for a quarter.

6. How much butter fat in 350 lb. of milk testing 4%?

7. Find the cost of

(a) 5 lb. cheese @ 35¢
(b) 6 grape fruit at 3 for 20¢
(c) 10 lb. sugar @ $19\frac{1}{2}$¢ (1920 price)
(d) 25 lb. butter @ 48¢
(e) 8 penknives @ $62\frac{1}{2}$¢
(f) 24 lb. rice @ $8\frac{1}{3}$¢
(g) 8 doz. oranges @ $37\frac{1}{2}$¢



8. What is 10% of 5280 ft.?

9. What was the range of temperature on a cold day when the mercury in the thermometer moved from 6° below zero Fahrenheit to 14° above zero?

10. What was the range of temperature on a hot day when the mercury moved from 68° Fahrenheit to 94°?

11. Find % of profit when the grocer sells berries costing 8¢ per box at 12¢.

12. A person sleeps from 10 P. M. to 6 A. M. What % of a day is that?

XVII

Percentage and Decimals Review

1. Divide .03 by .003, .2 by .02, 4 by .4.

2. How many yards of goods costing \$.62$\frac{1}{2}$ can be purchased for \$6.25?

3. Find .65 of \$824. What is 65% of \$412?

4. John allowed .3 of his spending money for movies, .4 for car tickets, and the remainder, which was 60¢, for baseball. How much did the movies cost?

5. A man gave 2% of his monthly salary check of \$200 to the Red Cross, 3% of it to local charity. He placed 20% of the remainder in his savings account. How much did he save each month?

6. What % of a man's monthly salary is spent for rent if his salary check is \$250 and his rent check is \$40? Who signs the rent check?

7. Write the check in the last problem, assuming that you are the landlord and that a classmate is the tenant.

8. A man spends \$22.50 for insurance, which is 6.2% of his monthly salary check. His other expenses amount to 62% of his check. What are the other expenses, and what per cent does he save?

9. What % of .8 of your money is .2 of it?

10. If \$12 is 60% of John's savings, what % is \$8?

11. If \$6 is 75% of Frank's money, find 37$\frac{1}{2}$% of it.

12. Three hits in 11 times at bat will give a boy what batting average?

13. What is the difference between $\frac{1}{2}$ of a mile and $\frac{1}{2}$% of a mile? Between $\frac{3}{4}$ of \$300 and $\frac{3}{4}$% of \$400?

XVIII

1. Estimate the length of your blackboard. Then measure it. Determine the accuracy of your estimate in per cent.

2. Estimate the area of your schoolroom floor. Compute the area after making the necessary measurements. Determine the accuracy of your estimate in per cent.

3. Estimate the capacity in cubic inches of a crayon box. Then measure its dimensions (inside or outside?) accurately to the nearest eighth inch. Compute the volume. Determine in per cent how much too low or too high your estimate was.

4. A boy said, "A box 8 in. by $5\frac{1}{2}$ in. by 5 in. contains a gallon." What mark would you give him on his estimate?

5. A high school graduate said, "A rod contains $16\frac{3}{4}$ ft." Determine the accuracy of this statement in per cent.

6. Another one said, "A rod contains $5\frac{1}{2}$ feet." What is the per cent of accuracy of this statement?

7. Allowing 38 cu. ft. to the ton, how many tons of soft coal in a bin 10 ft. by 8 ft. by 6 ft.? Estimate the answer, then compute it.

8. Allowing 34.4 cu. ft. to a ton, how much will it cost at $10.25 a ton to fill with anthracite coal a bin 12 ft. by 8.5 ft. by 5 ft.?

9. At $57\frac{1}{2}$ lb. to the cu. ft. find the weight of a block of ice 30 in. by 24 in. by 12 in.

10. Water weighs $62\frac{1}{2}$ lb. to the cu. ft. What part by weight is a cu. ft. of ice of a cu. ft. of water?

XIX

After reading the problem carefully, estimate the answer. Then solve it.

1 The mallard duck flies at an average speed of 75 ft. per second. How many miles is that an hour?

2. The canvasback duck flies at an average speed of 145 ft. per second. How much faster is that than an express train which averages 50 mi. per hour?

3. Some species of hawks can fly with a speed of 200 ft. a second. How long does it take them to fly a mile at this rate?

4. The common crow is a slow flying bird, making, when in full flight, 55 ft. per sec. How many miles is that an hour?

5. The Canada goose (wild goose) has an average speed of 110 ft. per sec. How far at this rate can it fly in 6 hr.?

6. On December 14, 1918, Lieutenant Jones left Houston Texas, in an airplane at 9:12 A. M., arriving at Waco at 11:50 A. M., distance 197 mi. What was the rate of speed per hour?

7. The plane in problem 6 flew against a wind blowing 45 miles per hour. What was the actual speed generated by the engine of the plane mentioned?

8. Compare this speed with that of the hawk in problem 3.

9. A passenger train ran 60 miles in 80 minutes. Compare this speed with that of the mallard duck in problem 1.

10. 80 miles per hour is how many feet per minute? How many feet per second?

11. Which is faster, 50 ft. per sec. or 31 mi. per hour?

XX

In each of the following write in good English what additional fact or facts you must know and what you must do.

1. Given the sum of two fractions, find one fraction.

2. Given how many pupils are present, find the % absent.

3. Given the quotient, find the divisor.

4. Given the remainder, find the subtrahend.

5. Given the yearly interest on one of my Liberty Bonds, find the interest on all of them.

6. Given three letters to be stamped and registered, find the total cost.

7. Given the area of a rectangular lot, find the width.

8. Given the cost of a suit of clothes, find the selling price.

9. Given the profit, find the % of profit.

10. Given the distance between two stations on a railroad, find the average speed of an express train.

11. Given the weight of 3 boys, find the weight of the heaviest one.

12. Given the cost of a ton of soft coal, find the cost of a bushel.

13. Given the weight of a peck of potatoes, find how many bushels in a given number of pounds.

14. Given the selling price of a loaf of bread, find the rate of profit.

15. Given the volume in cubic inches in a bucket, find how many gallons in it.

CHAPTER IV

EARNING AND SAVING

Cash and Carry

1. Some grocers sell by the **cash and carry plan** or by the **credit and delivery plan.** This means that they sell cheaper to those customers who pay cash and carry their purchases than to those who wish their purchases delivered.

The schedule on the next page shows the prices in 1918 of certain commodities under each plan.

Commodity	Cash and Carry	Credit and Delivery
Potatoes, per lb.	$ .03	$ .032
Sweet potatoes, per lb.	.06	.065
Tub butter, per lb.	.69	.70
Dressed hens, per lb.	.33	.36
Eggs, per doz.	.73	.74
Corn meal, per lb.	.05	.052
Fancy bacon, per lb.	.56	.57
Corn syrup, 5 lb. can	.40	.45
Navy beans, per lb.	.13$\frac{3}{4}$	.14$\frac{3}{4}$
Rice, per lb.	.13$\frac{1}{2}$	.14$\frac{1}{2}$
Corn oil, per gal. can	2.75	2.95
Flour, 24-lb. sack	1.56	1.59

2. John's mother agreed to give him all that could be saved by the cash and carry plan if he would make the purchases, carry them home, and keep the account.

3. During October he made the following purchases for his mother: 30 lb. potatoes, 10 lb. sweet potatoes, 4 lb. butter, a 6-lb. hen, 5 lb. fancy bacon, 10 lb. corn sirup, 4 lb. navy beans, 2 lb. rice, 1 gallon of corn oil. Find his earnings.

4. The next month his neighbor, Mrs. Smith, allowed him to be her grocer boy under the same conditions stated in problem 2. During this month he purchased for Mrs. Smith and for his mother as follows: 60 lb. potatoes, 10 lb. sweet potatoes, 10 lb. butter, 3 5-lb. hens, 5 lb. corn meal, 4 doz. eggs, 48 lb. flour, 20 lb. sirup, 6 lb. bacon, and 2 gallons corn oil. Find his earnings for November.

5. In December another neighbor, Mrs. Jones, was glad to employ him. His purchases this month for the three families were as follows: 100 lb. potatoes, 20 lb. sweet potatoes, 15 lb. butter, 3 5-lb. hens, 6 doz. eggs, 9 lb. bacon, 15 lb. navy beans, 15 lb. sirup, 48 lb. flour, and 3 gal. corn oil. What did he earn in December?

6. How much did John earn as grocer boy in 3 months?

7. Mrs. James Foote bought the following bill on the cash and carry plan at the prices shown on the previous page: 15 lb. Irish potatoes, 2 doz. eggs, one sack flour, 3 lb. bacon, 4 lb. navy beans. How much did she save by this plan? What % did she make on her investment? She gave her saving to her ten-year old son for delivering. What do you think of her plan?

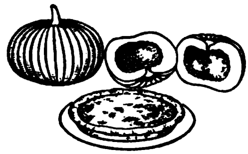
8. Mrs. Jones bought on the same day the following bill of groceries on the credit and delivery plan: 15 lb. Irish potatoes, 4 lb. sweet potatoes, 5 lb. corn meal, 3 lb. bacon, a 5-lb. can of sirup, 6 lb. navy beans. How much would she have saved by the cash and carry plan?

9. In 1918 Karo sirup sold at 15¢ per $1\frac{1}{2}$ lb. can and at 35¢ per 5 lb. can. Which is the more economical plan and how much in the case of a family which used 30 lb. in two months? What % was saved on the investment? Under what conditions is it economical to buy groceries in quantity?

10. When baked beans in 11 oz. cans were selling at 15¢, the same quality could be bought in 23 oz. cans at 20¢. If a family can use a 23 oz. can per week, what is the saving in 4 weeks by buying large cans rather than small cans?

11. Corn oil was sold in 1918 in cans of 3 sizes: pints at 40¢, quarts at 70¢, and gallon cans at $2.50. How should it be bought by a family using a gallon per month? What is the % of saving? How should it be bought by a family needing one quart per month? What is the % of saving?

1. The following are the ingredients* for the filling of one pumpkin pie: 1 cup of stewed pumpkin, 1 cup of milk, 1 egg, $\frac{1}{2}$ cup of sugar, 1 teaspoon of cinnamon, $\frac{1}{2}$ teaspoon each of ginger and nutmeg. How much of each for 2 pies?



2. Allowing one pie to 6 persons, find the multiplier by which you must increase the above recipe if you want to bake pumpkin pies for a Thanksgiving party of 15 persons. Estimate the cost of these ingredients in your neighborhood. To find the cost of the pies if homemade, what else must you know?

3. When Northern Spy apples are canned, 1 cup of sugar is generally allowed to each quart of cooked apples. What is the cost of the sugar at 10¢ a lb. for 12 quarts?

4. 50 medium sized Jonathan apples, 3 qt. of cider, 3 cups of sugar, and 3 teaspoons of spice are required for one gallon of apple butter. How much of these ingredients will be required for 6 gallons? Estimate the cost of 3 gallons at prices current in your neighborhood.

5. This is a common recipe for ice cream: 1 qt. of milk, 1 cup of sugar, 1 cup of cream. This recipe will serve 10 people. At the prices charged for the materials in your neighborhood, find the cost of the ice cream for 20 people, if you allow 20¢ for ice and salt.

*Note.—In computing recipes use this table.

2 cups = 1 pt.
1 cup = $\frac{1}{2}$ pt.
1 pt. = 1 lb.
2 teaspoonfuls = 1 tablespoonful.

Knowing Food Values

I. If you use milk as a standard, or measure of value, calling its food value 1 unit per lb. (1 lb. = 1 pt.), then dry wheat flour has a value of 5 units; cured meat, 5 units; bread, 3.3 units; eggs, 4 units; fresh meat, 2.5 units; cabbage and other vegetables such as carrots and turnips, .4 unit.

1. When milk is selling at 7¢ a lb., what can I afford to pay a pound for turnips to get an equivalent food value for my money? Call a pint of milk a pound.

2. With milk at 7¢ a lb., is the buyer getting his money's worth out of bacon selling at 45¢ a lb.?

3. On a certain day carrots sold at 2¢ per lb., turnips @ 3¢, and cabbage @ $3\frac{1}{2}$¢. From the standpoint of food value which of these was the most economical purchase?

4. When milk is selling at 6¢ per lb., what can we afford to pay for bread? for fresh meat? Is it necessary to pay this much for bread?

5. Which is cheaper if milk is worth 7¢ a pint (pound), sugar cured ham at 35¢, or round steak at 30¢?

6. When milk on the farm is worth $3 per hundred pounds, what is fresh pork worth in food value?

II. In food value 1 lb. cottage cheese = 1.27 lb. sirloin steak = 1.09 lb. round steak.

1. When cottage cheese is worth 18¢ a lb., what is the food value of 1 lb. of sirloin steak?

2. In 1918 sirloin steak sold at 40¢ a lb. How much cottage cheese at 18¢ a lb. could be bought for the cost of 1 lb. of sirloin steak? Which is the better purchase?

1. Phil Robyn of Augusta, Mo., reported the following record of 10 high grade White Leghorn pullets from October 1, 1917, to September 30, 1918.

Eggs laid, 1935, valued at	$63.72
Cockerels sold during summer of 1918	9.04
Raised 21 pullets during summer of 1918 valued at $1.50 each	?
Total	?
Feed for one year	$35.22

(1) Find the total receipts for the year from the flock.

(2) What was the net profit? How much per hen?

(3) Find the average number of eggs laid per month. The average per hen per month.

(4) What were the monthly earnings of the flock? What was the monthly cost? The monthly net profit? What was the % of profit?

(5) Mr. Robyn accomplished these results in a small backyard poultry pen in town, buying all the feed. Was it a profitable undertaking?

2. In the first 21 days of December, 1918, 21 yearling hens laid 282 eggs. During this time these birds ate 110 lb. of feed costing 3¢ a lb. In this month fresh eggs were worth 75¢ a doz.

(1) Find the value of the eggs laid.

(2) Find the total profit.

(3) How much on an average did each hen earn in 21 days? How much in one day?

(4) What was the feed cost to produce one egg?

(5) How much of egg value did each pound of feed produce?

Feeding Poultry

Poultry feed consists of dry mash and scratch feed.

I. A standard dry mash mixture consists of these ingredients: bran, 2 parts; shorts, 2 parts; oil meal, 1 part; beef scraps, $1\frac{1}{3}$ parts; alfalfa meal, 2 parts.

1. If I have 100 lb. of bran, how much of each of the other ingredients must I buy to make a mixture of the kind named?

2. What will be the total weight of the mixture?

3. If the daily allowance per hen of this kind of food is 2 ounces, how long will this mixture last 12 hens?

II. Scratch feed may consist of cracked corn 13 parts; rye, 1 part; feed wheat, 1 part.

1. How much rye and corn must be added to 20 lb. of feed wheat to make a mixture of this kind?

2. Counting corn at $2\frac{1}{2}$¢ a lb., rye at 2¢ a lb., wheat at 3¢, find the total cost of this mixture.

3. If 2 oz. per hen are allowed as the daily ration of this type of feed, how long will the mixture in problem 2 last 12 hens?

4. What is the daily cost per hen for scratch feed in problem 3?

5. Dry mash feed costs more per lb. than scratch feed. What are the ingredients which increase the price?

6. If you are keeping poultry, do you think it worth while to keep an accurate record of the receipts and expenditures with it?

1. Maurice, a New Haven boy, received from his neighbor 15¢ a day for building the furnace fire in the morning, covering the fire at night, and carrying the ashes. He began Oct. 15, 1918, and quit at night April 15, 1919. Find out how much he received for this work.

2. John, a Chicago boy, shoveled snow during the winter of 1919 for his father and neighbors in his block at 25¢ an hour. In January he worked 10 hours, in February 15 hours, and in March 10 hours. What were his total earnings at this work?

3. Do you think there are boys in Pittsburgh who could find jobs as furnace boys? Do you think there are people in Pittsburgh willing to pay a careful boy 15¢ a day for the kind of work done by the New Haven boy?

4. Do you think there are opportunities for Cleveland boys to shovel snow?

5. Frank and Roy, two Cincinnati boys, worked together cleaning the ice and snow from sidewalks. They charged a cent per linear foot of walk. In December they cleaned 400 ft., in January 850 ft., in February 740 ft., in March 860 ft. They agreed to spend 20% of their earnings and invest the balance in thrift stamps at 25¢ each. How many did they buy? How might they divide the stamps?

6. Name other ways in which you have known boys and girls to earn money before and after school hours during the winter.

7. Do you know any boys and girls who are saving their money? Why should people save money? What can be done with money to make it earn money?

Buying Coal and Wood

Use these facts in solving fuel problems.

128 cu. ft. = 1 cord of 4-ft. wood.
80 lb. = 1 bu. of coal. 25 bu. = 1 ton of coal.
2000 lb. = 1 ton. 2240 lb. = 1 long ton.
38 cu. ft. = 1 ton soft coal. $34\frac{1}{2}$ cu. ft. = 1 ton hard coal.

1. A family needs 4 tons of coal for December and January. In November coal is selling at 16¢ per bu., or at $3.80 per ton if bought in 2-ton lots. What is the saving by the latter plan?

2. In May the price of coal is as a usual thing cheaper than in December. In a certain year the May price was $3.50 per ton, and the December price was $3.90 for the same grade. By buying in May what per cent on his investment does a person make who needs 12 tons from December till spring?

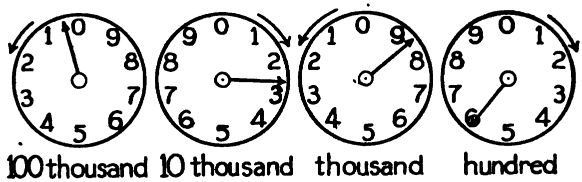
3. In some cities hard coal is usually double the price of soft coal. Why? What is the leading anthracite state in the United States?

4. How many tons of hard coal (anthracite) will a bin 12 ft. long, 8 ft. wide, 7 ft. deep hold when full to within 1 ft. of the top? How many tons of soft coal (bituminous)?

5. An 8th grade boy wished to build in a basement 7 ft. high a bin to hold 7 tons of bituminous coal. What should the other dimensions be? Estimate the answer.

6. A dealer buys coal at $4 per long ton and sells it at $4 per short ton. What is his profit per long ton?

7. Find the cost of a pile of wood 12 ft. long, 4 ft. wide, 6 ft. high at $3 per cord.



A Four-dial Meter—Cubic Feet

The figures on the right hand dial represent hundreds of cubic feet; those on the next to the left, thousands of cubic feet; those on the next, tens of thousands; and those on the last, hundreds of thousand cubic feet.

To read the meter shown in the figure always write the figure of **least** value **nearest** to the hand, beginning at the left dial; thus, 0; next dial, 2; next, 8; next, 6; then annex two zeros. The reading is 28600 cubic feet.

1. If the reading previous to the one above was 15,900 cubic feet, how much gas was used between the two readings?

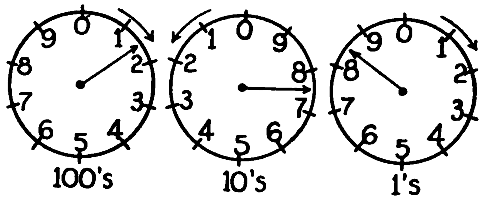
2. On May 10, 1919, a certain gas meter read as shown in the dials, namely 28,600 cubic feet. June 10 it was found that the family had used 2700 cu. ft. during the month. Construct the dials showing the proper reading on June 10.

3. Find the cost of the gas used in problem 2 at 90¢ per 1000 cu. ft.

4. A discount of 10% is allowed for prompt payment. How much is the discount on the above bill?

5. If the above is an average monthly bill, how much may a family save in a year by paying gas bills promptly? Do you think it pays to meet gas bills promptly?

Buying Electricity



A Three-dial Meter—Kilowatt Hours

1. Study once more the directions for reading the gas meter on page 237.

2. Using those directions, read the meter above.

3. On April 1, 1919, a certain meter read 197 kwh. (kilowatt hours). Construct the dials for this reading.

4. If the meter in problem 3 read 217 on May 1, compute the cost of electricity used at 8 cents per kilowatt hour, allowing 5% discount for prompt payment.

5. By careful use of the lights the family found the next month's bill to call for 16 kilowatt hours instead of 20. What % did they save on their bill? Is such a rate of saving worth while?

6.

Union Electric Light and Power Co.

12th and Locust Sts. June 19, 1920.

For electric service from May 16 to June 15.

Last reading	166		Net bill if paid on
Previous "	158	Gross bill	or before July 1
Kilowatt hours	8	64¢	61¢

On page 238 is a copy of a monthly electric light bill.
(1) What is the gross charge per kilowatt hour?
(2) What is the rate of discount allowed for cash?
(3) What will settle the bill if not paid until July 2?

Teamwork

1. A 6th grade girl with the help of her father raised during the summer of 1919 the following vegetables in a back yard garden of a large city: 40 heads of lettuce, 192 radishes, 52 lb. of string beans, 124 lb. of tomatoes, 40 bunches of carrots, and 60 lb. of squashes.

Find the value of each of these items if bought in your community. Then determine how much this girl by her garden efforts helped to reduce the household expense.

At the close of the season the father gave his daughter a check for the value of the garden stuff in the above problem. Write the check which she received.

2. Two girls received \$2.40 for making button holes. One made 75; the other made 45. How shall they divide the money?

3. When canned peas were retailing at 2 for 25¢, three ladies bought a case of 36 cans for \$3.60. One took 16 cans; another took 12; the third took 8. How much of the bill should each pay? How much did each save by this plan of buying?

4. When apples were retailing at 60¢ a peck, Mr. Jones and Mr. Smith, two neighbors, bought from the grower a barrel containing 11 pk. for \$4. Express charges were 80¢. If they divided the apples equally, how much money did each save? What was the % of saving?

Interest

Men who save their money by investing it properly make it earn more money for them. One of the methods of investing money is lending it. Such money is called **a loan.**

The money which money earns is called **interest.** Another way of saying it is, **Interest is money paid for the use of money.** The money used is also called the **principal.**

1. John earned and saved $5. His father paid him 30¢ for the use of it for one year. $5 is the _____ and 30¢ is the _____.

2. What % of $5 is 30¢?

3. The part, or %, of the principal which is paid for the use of the principal for one year is called the **rate of interest.** What rate of interest did John's father pay him?

4. If John's father paid him interest on $5 for 5 years at the rate found in problem 3, how much interest did he owe John at the end of 5 years? How much was the total debt?

5. The principal and interest together are called the **amount.**

$5.00 New Haven, Ct., *Sept. 1, 1915*

Five years after date *I* promise to pay

John Clarke or order,

Five Dollars

with interest at 6% per annum. For value received.

James Clarke

A PROMISSORY NOTE

6. In the transaction on page 240 name the principal, the interest for 1 yr., for 5 yr., the rate of interest, the amount.

7. When John's father borrowed the money, he gave a **promissory note.** See page 240.

8. Read the note once more on page 240. Then answer the following questions. Who is the borrower? Who is the lender? Who keeps the note? Who signs the note?

9. Write a promissory note for Ten Dollars at 5% interest, due in two years, in which you are the borrower and a classmate is the lender.

Interest Problems

1. Find the interest on $2 at 5% for 1 year. For 2 yr. For 4 yr.

2. What is the interest on $100 at 6% for 1 yr.? For $\frac{1}{2}$ yr.? For $2\frac{1}{2}$ yr.?

3. When you know the interest for 1 year, how can you find it for 1 month? For 2 months? For 11 months?

4. What is the interest on $20 at 6% for 1 yr.? For 1 month? For 2 months? For 11 months? For 1 yr. 11 mo.?

In computing interest use 30 days to the month, 12 months to the year, and 360 days to the year.

5. If you know the interest for 1 mo., how do you find it for 1 day? For 10 days? For 15 days? For 20 days?

6. If the interest for 1 mo. is $12, find it for 1 day, for 10 days, for 15 days, for 20 days.

7. Find the interest on $200 at 6% for 1 month, for 15 days, for 1 day.

Savings Accounts

1. Some banks will allow a person to open a savings account with $1.

2. Sometimes as much as 4% per annum (a year) is paid on all sums left 30 days, or longer.

3. The interest is usually computed Jan. 1 and July 1 and added to the account. Fractional parts of a month and of a dollar are not counted in computing the interest, except that deposits made between the 1st and 5th of any month are computed as if made on the 1st of the same month.

4. In making a deposit at a bank for a savings account a deposit slip similar to the one shown here is filled out by the person making the deposit. After it is properly filled out, this slip, the money, and the depositor's pass book are handed to the receiving teller. He makes the proper entry in the depositor's pass book and returns it to the one making the deposit.

Deposit Slip

Deposited to the Credit of

Name________________

Address________________

IN THE

Oak Grove Savings Bank

Pass Book No.______

Date__________192__

	Dollars	Cents
Bills		
Silver		
Other Coins		
Checks		
Total		

5. A girl deposits 3 one dollar bills, 2 quarters, 2

dimes, 3 nickels, and 15 pennies in a savings bank. What sum of money should she write on the deposit slip after **Bills?** What sum after **Silver?** What sum after **Other Coins?** After **Total?**

6. Mary Howe, address 3510 Park Ave., April 1, 1920, deposited 2 two-dollar bills, 3 one-dollar bills, 2 half dollars, 4 quarters, 5 dimes, 6 nickels, and 30 pennies. Rule a sheet of paper and make her deposit slip.

7. A Sherman School boy started a savings account*, earning 4% interest, with $2 Feb. 1, 1919. He earned and deposited as follows: Mar. 1, $3.00; Apr. 1, $2.00; May 1, $2.00; June 1, $5. Find the value of his account on July 1, 1919. How many cents must he add on July 2 to make his account an exact number of dollars?

HINT.—He had at interest $2 for 5 mo.; $3 for 4 mo.; $2 for 3 mo.; $2 for 2 mo.; $5 for 1 mo.

8. On July 3, 1919, the boy named in problem 7 deposited to his account $2.88; Aug. 1, $4.00; Sept. 1, $5.00; Oct. 1, $2.00; Nov. 1, $3.00; Dec. 1, $2.00. Find the value of his account Jan. 1, 1920. How many cents must he add on Jan. 2 to make his account an exact number of dollars? Why should he want his account in this condition?

9. Harry Smith on Jan. 1, 1920, had $15 in a savings account which was earning 3% interest. He added $5 to this account on the first of each month after January during the year. Find the value of his account on July 2, 1920; on Jan. 1, 1921.

* NOTE.—If you would have your savings account do its maximum amount of work for you, never withdraw money.

Postal Savings Banks

Postal Savings Banks were established by an Act of Congress approved June 25, 1910. Any person ten years old or older may open a postal savings account at any United States depository postoffice. The smallest deposit received is $1. No one may deposit more than $100 in any one month, nor must the balance, not counting interest, at any one time be more than $500. The payment of such deposits is secured by the United States.

Depositors are given postal savings certificates as receipts for their deposits. Such certificates are issued in denominations of $1, $2, $5, $10, $20, $50, and $100. These certificates earn 2% interest, payable yearly. Interest is not paid for a part of a year. Interest begins on the first of the month following the month in which the deposit is made. A depositor may secure interest on interest by withdrawing the interest due him and depositing it with enough to make the minimum deposit of $1.

Postal savings certificates cannot be sold and payment on them is made to the depositor himself except in the case of his death or his inability to appear in person.

The U. S. Postal Savings Card is a plan to help persons to save amounts smaller than $1. See the figure on the next page for the form of such a card and for an explanation how to use it.

A depositor may exchange postal savings certificates for United States registered or coupon bonds in denominations of $20, $100, or $500. These bonds earn $2\frac{1}{2}$% interest, payable January 1 and July 1.

Problems

1. On January 1, 1910, a 10-year old boy bought a postal savings card. On Jan. 8 and each week thereafter he attached a 10¢ postal savings stamp. When was the card full? What was done with it? On what day did the investment begin to earn interest?

2. During 1910 the boy named in problem 1 was given an investment allowance of 10¢ a week. With it he bought a postal savings stamp each week except the last two weeks in December. How many $1 certificates did he buy during the year? When did each certificate begin to earn interest?

3. The allowance in problem 2 continued for five years. How many $1 certificates did he buy during this period? How much interest was there to his credit Jan. 1, 1915? Interest is allowed for full years only.

4. On January 1, 1915, the interest in problem 3 was converted into $1 certificates. How many did he buy?

5. On January 1, 1915, the weekly allowance ceased. During the next three years he bought two $1 certificates weekly for 50 weeks from his earnings after school and during vacation. How much money did he have in the bank January 1, 1916? How much on January 1, 1917?

6. On January 1, 1917, he drew the interest due and converted it into $1 certificates. How many did he buy and how many cents were over?

HINT.—Remember that his $26 in bank January 1, 1915, earned interest for two years.

7. How much was his savings account worth Jan. 1, 1918?

8. On January 1, 1918, a speculator offered to borrow the boy's money at 8% interest. How much more interest on each $100 does 8% earn than 2%?

9. The boy refused the offer. Can you think of a good reason why? What should you know about people before lending them money? Is an offer of a **high** rate of interest usually a **safe** offer?

10. On January 2, 1918, the boy converted his savings account into 4% $50 bonds of the Second Liberty Loan. How much money did he add to his postal savings account in order to buy 7 such bonds at $50 each?

11. If the boy invested the interest from his bonds in Postal Savings certificates, how much did he add to it on December 31, 1918, to buy 15 one dollar certificates? Why did he make this investment on December 31?

"Safety first" is a good motto for investors who must earn their money.

CHAPTER V

Exercises for Speed and Accuracy

I

Addition Speed Test

Write answers only. See how many of these you can do right in 8 minutes. *If your accuracy is below 90%, spend 8 minutes each day until you can do 8 right.

208	217	586	359	803	597
984	173	324	235	924	383
352	538	247	714	652	708
745	625	170	129	260	227
497	209	958	647	545	474
176	994	435	280	381	566
569	380	913	486	769	690
623	456	692	592	827	815
838	661	709	678	138	189

842	539	975	908	751	648
287	673	457	762	839	276
940	927	293	273	986	382
694	135	709	537	474	401
738	278	648	154	318	514
429	892	126	891	563	720
365	506	561	389	635	199
506	764	834	616	147	865
179	410	397	445	292	907

* NOTE.—A short daily practice period of this kind is valuable for all who wish to become good computers.

II

Subtraction Speed Test

Practice 4 minutes each day until you can do 8 right.

92531839	122362975	87545006	181540147
54232991	91392880	79306239	99620308
15025346	105604633	116504717	114126502
12009056	94372654	46423608	57107940

III

What must you add to each of these numbers to make 100? Read the answers.

25	37	84	52	33	19	82	76	53	96	24	15	22	38	23
32	56	91	36	46	83	25	28	14	41	87	27	20	39	50

IV

Business men and clerks make change by the adding method. Make the change for the following purchases.

	Purchase	Amt. Given	Change		Purchase	Amt. Given	Change
1.	$3.57	$4.00	?	11.	$2.25	$10.00	?
2.	.33	1.00	?	12.	1.23	5.00	?
3.	1.52	5.00	?	13.	.60	2.00	?
4.	.15	.50	?	14.	1.10	5.00	?
5.	.23	5.00	?	15.	.37	.50	?
6.	2.52	3.00	?	16.	.61	.75	?
7.	.96	10.00	?	17.	1.29	10.00	?
8.	.87	1.00	?	18.	13.20	20.00	?
9.	1.13	2.00	?	19.	15.46	20.00	?
10.	.57	1.00	?	20.	9.81	10.00	?

V

Find out what each means in plain English, then write on another sheet the answer for the question mark.

1. $\frac{5}{6}\times 24=?$	8. $15\times ?=5$	15. $10\times 0=?$
2. $\frac{3}{4}\times 0=?$	9. $\frac{7}{8}\times 56=?$	16. $18\times 1\frac{1}{2}=?$
3. $36\times\frac{5}{9}=?$	10. $?\times\frac{1}{2}=25$	17. $9\times 2\frac{1}{2}=?$
4. $3\times ?=2\frac{1}{4}$	11. $3\times\frac{1}{3}=?$	18. $16\times\frac{7}{8}=?$
5. $4\times 1\frac{1}{4}=?$	12. $8\times ?=20$	19. $30\times ?=20$
6. $7\times ?=1\frac{3}{4}$	13. $9\times 1\frac{3}{4}=?$	20. $?\times\frac{2}{3}=12$
7. $?\times\frac{1}{4}=3$	14. $100\times ?=75$	21. $?\times\frac{5}{6}=15$

VI

Write answers only.

1.	2.	3.
$2\times 1\frac{1}{2}=$	$2\times 2\frac{1}{2}=$	$2\times\frac{3}{4}=$
$3\times 1\frac{1}{2}=$	$3\times 2\frac{1}{2}=$	$3\times\frac{3}{4}=$
$4\times 1\frac{1}{2}=$	$4\times 2\frac{1}{2}=$	$4\times\frac{3}{4}=$
etc., to $12\times 1\frac{1}{2}=$	etc., to $12\times 2\frac{1}{2}=$	etc., to $12\times\frac{3}{4}=$

4.	5.	6.
$2\times 1\frac{1}{4}=$	$2\times 3\frac{1}{3}=$	$2\times\frac{7}{8}=$
$3\times 1\frac{1}{4}=$	$3\times 3\frac{1}{3}=$	$3\times\frac{7}{8}=$
$4\times 1\frac{1}{4}=$	$4\times 3\frac{1}{3}=$	$4\times\frac{7}{8}=$
etc., to $12\times 1\frac{1}{4}=$	etc., to $12\times 3\frac{1}{3}=$	etc., to $12\times\frac{7}{8}=$

VII

Find out how long it takes you to write the answers for the following. Record your result. If you do not have a perfect score, try again in one week from today.

1. $.75+1.25=?$
2. $2.37+5.73=?$
3. $\frac{3}{4}+\frac{5}{8}=?$
4. $9-2.82=?$
5. 60% of $\$120=?$
6. $8.4\div.4=?$
7. $2.5\times.5=?$
8. $6.3\div.9=?$
9. 2% of 400 ft. $=?$
10. $\frac{3}{4}\times\frac{7}{8}=?$
11. $2\frac{1}{2}+6.6=?$
12. $3\%+.56=?$
13. $\frac{1}{8}-2\%=?$
14. $\frac{3}{4}-75\%=?$
15. $\frac{1}{2}+50\%=?$
16. 50% of $.5=?$
17. $\frac{7}{8}\times\$24=?$
18. $37\frac{1}{2}\%\times\$16=?$
19. $37\frac{1}{2}\%+.37\frac{1}{2}=?$
20. $\frac{1}{2}\%$ of $\$200=?$
21. $24:16=?$
22. $25\%:50\%=?$
23. $25\times84=?$
24. $\$6\div75¢=?$
25. 2 yd. : 1 ft. $=?$
26. $12\times13=?$
27. $8\div\frac{1}{2}=?$
28. $62\frac{1}{2}\%$ of $\$32=?$
29. $125\%\times40=?$
30. $112\frac{1}{2}\%\times\$16=?$
31. 6 for $\$1\frac{1}{2}=1$ for ?
32. 8 for \$1 = 3 for ?
33. 9 for 27¢ = 6 for ?
34. 12 for 100¢ = 3 for ?
35. 18 for 50¢ = 9 for ?
36. 3 for \$2 = 6 for ?
37. 2 for 50¢ = 10 for ?
38. 16 for \$1 = 4 for ?
39. 16 for \$1 = 12 for ?
40. 3 for 10¢ = 12 for ?
41. 5 for 25¢ = 6 for ?
42. 12 for 50¢ = 3 for ?
43. \$8 for 12 = 3 for ?
44. \$10 for 12 = 9 for ?
45. At 2¢ each = ? for 20¢
46. At $2\frac{1}{2}$¢ each = ? for 10¢
47. At $\$2\frac{1}{2}$ each = ? for \$20
48. At $6\frac{1}{4}$¢ each = ? for 25c
49. At $8\frac{1}{3}$¢ each = ? for 25¢
50. At $2\frac{1}{2}$¢ each = ? for 75¢
51. At 50¢ each = ? for \$2
52. At $\$\frac{1}{2}$ each = ? for 50¢
53. At $\$\frac{2}{3}$ each = ? for \$2
54. At 75¢ each = ? for \$3
55. At $\$1\frac{1}{2}$ each = ? for \$6
56. At 10¢ each = ? for \$2
57. At 5¢ each = ? for 30¢
58. At 25¢ each = ? for \$1.50

VIII

Write the products only. Find the total of each problem. Time your work. A good 6th grade pupil should compute correctly the three problems in 10 minutes.

1. O. A. Cramer sold N. J. Sands during May, 1920, groceries and fruits as follows:

May 3. 3 doz. bananas @ 25¢.
May 4. $1\frac{1}{2}$ doz. oranges @ 30¢.
May 6. 2 doz. eggs @ 58¢.
May 7. A 6 lb. hen @ 35¢ a lb.
May 10. 6 lb. sugar @ $30\frac{1}{2}$¢.
May 17. 2 lb. butter @ 62¢.
May 18. 3 lb. lard @ 28¢.
May 24. 5 lb. rolled oats @ 6¢.
May 25. 6 lb. apples @ 15¢.
May 27. 2 lb. Wisconsin cheese @ 38¢.

STATEMENT

N. J. Sands

To O. A. CRAMER, Dr.

May 3	3 doz. bananas @ 25c.		
May 4	$1\frac{1}{2}$ doz. oranges @ 30c.		
May 6	2 doz. eggs @ 58c.		
May 7	A 6 lb. hen @ 35c a lb.		
May 10	6 lb. sugar @ $30\frac{1}{2}$c.		
May 17	2 lb. butter @ 62c.		
May 18	3 lb. lard @ 28c.		
May 24	5 lb. rolled oats @ 6c.		
May 25	6 lb. apples @ 15c.		
May 27	2 lb. Wisconsin cheese @ 38c		

2. During April, 1920, the Kreeger Grocery Company sold John Jones groceries and meats as follows:

Apr. 1. 15 lb. Willow Twig apples @ 12¢.
Apr. 2. 4 lb. Forest Park butter @ 65¢.
Apr. 3. 3 doz. Country Club eggs @ 68¢.
Apr. 6. 4 loaves of white bread @ 10¢.
Apr. 8. 15 cans of Shoe Peg corn @ 12¢.
Apr. 12. 12 cans Country Club tomatoes @ 13¢.
Apr. 15. 1 sugar cured ham weighing 12 lb. @ 30¢ a lb.
Apr. 17. 4 boxes shredded wheat biscuits @ 13¢.
Apr. 19. 4 boxes grapenuts @ $12\frac{1}{2}$¢.
Apr. 20. 2 lb. soda crackers @ 22¢.

3. During April, 1920, The Grand Leader sold Mrs. John Adams goods as follows:

Apr. 2. 9 yd. lace @ 20¢.
Apr. 3. 12 yd. lawn @ 25¢

Apr. 6. 11 yd. cambric @ 25¢.
Apr. 9. 4 yd. muslin @ 28¢.
Apr. 12. 5 yd. gingham @ 69¢.
Apr. 15. 2 pr. of low shoes @ \$9.95.
Apr. 17. 2 silk skirts @ \$7.95.
Apr. 21. 2 girls' white dresses @ \$3.69.
Apr. 24. 1 boy's blue serge suit @ \$8.95.

IX

Find the cost to the nearest cent of each of the following purchases when the price is $12\frac{1}{2}$¢ per yd.

Think $12\frac{1}{2}$¢ = \$$\frac{1}{8}$. Change the mixed numbers to mixed decimals.

SOLUTION.—5.50 yd. @ \$$\frac{1}{8}$ = \$.69. Think "8 into 55 = 6, 8 into 70 almost 9." Write \$.69.

14 yd.	13 yd.	9 yd.	$3\frac{3}{4}$ yd.	$3\frac{1}{2}$ yd.	$4\frac{3}{4}$ yd.
$7\frac{1}{2}$ yd.	$2\frac{1}{2}$ yd.	$1\frac{1}{2}$ yd.	$8\frac{3}{4}$ yd.	$1\frac{3}{4}$ yd.	$3\frac{1}{2}$ yd.
$7\frac{3}{4}$ yd.	$4\frac{1}{2}$ yd.	$8\frac{1}{2}$ yd.	$14\frac{3}{4}$ yd.	$6\frac{1}{2}$ yd.	$1\frac{1}{2}$ yd.
$5\frac{1}{4}$ yd.	$4\frac{1}{2}$ yd.	$11\frac{1}{4}$ yd.	$20\frac{1}{2}$ yd.	$21\frac{1}{4}$ yd.	$19\frac{1}{4}$ yd.

X

Sales Account for the Week Ending Jan. 24, 1920.

Find the value of each question mark. What does each represent?

Date	Clothing	Shoes	Dry Goods	Groceries	Hardware	Total
Jan. 19	\$44.14	\$25.50	\$58.95	\$64.35	\$28.40	?
Jan. 20	61.16	41.30	67.29	75.25	36.10	?
Jan. 21	59.25	39.80	48.45	61.01	27.75	?
Jan. 22	37.75	16.70	45.77	90.05	28.95	?
Jan. 23	164.90	39.55	96.12	68.80	146.50	?
Jan. 24	151.35	115.00	199.50	115.20	151.90	?
Total	?	?	?	?	?	??

XI

1. A gas bill for a certain month was 99¢, but only 88¢ if paid within 10 days. What was the rate of discount? What was the % of saving?

2. At an after Christmas sale $20 suits sold for $18. What was the rate of discount? What was the % of saving to the buyer?

3. In December, 1917, stick candy sold at 4 lb. for $1. In December, 1918, the same quality sold at $2\frac{1}{2}$ lb. for $1. What was the % of increase?

4. What is the % of increase when cookies usually sold at 6 for a nickel are selling at 1 cent each?

5. On January 1, 1919, Jumbo peanuts retailed at 35¢ a lb. One month later they were sold at 20¢ a lb. What was the % of reduction?

6. At Cleveland, O., on January 1, 1919, corn sold at $1.63 per bushel; on February 1, the same grade sold at $1.42. Find the % of decline.

7. Oats in one month in 1919 dropped from 74¢ a bushel to 63¢. What was the % of reduction?

8. When men's suits are reduced from $35 to $29, what is the % of reduction?

9. Find the % of reduction in each of the following items, which were advertised in an after Christmas sale.

Regular Price	Article	Sale Price
1. $18.00	4 Mahogany tables	$15.00
2. $52.00	3 Oak extension tables	$35.00
3. $48.50	2 Walnut chiffoniers	$30.00
4. $74.00	3 Singer sewing machines	$42.00

XII

1. If 12 biscuits require 1 tablespoonful of butter, $\frac{3}{4}$ cup of milk, 2 cups of flour, 4 teaspoonfuls of baking powder, 1 teaspoonful of salt, and 1 tablespoonful of lard, how much should be used for 18 biscuits?

2. If $\frac{3}{4}$ of a pound of wheat flour will make a one-pound loaf of bread, how many loaves can be made out of 1 bbl. of flour (196 lb.)?

3. The following is a standard recipe for ice cream: 1 qt. of milk, 1 cup of sugar, 1 cup of cream. At current prices in your neighborhood, what would be the cost of the ice cream if you allow 10¢ for ice and salt?

This recipe will serve 10 people. How much will it cost to serve a party of 9 girls and 9 boys?

4. After using 5 qt. of flour for bread, 3 cups for biscuits, and 3 cups for pies, what % of a 25-pound sack remains?

5. On August 15 my gas meter read 17,800 cubic feet; on September 15 it read 20,400 cubic feet. What was the bill for the month at 90¢ per 1000 cubic feet? If the bill is paid before September 25, a discount of 10% is allowed. How much may be saved by prompt payment?

6. Mary's mother can afford to pay $8 for the goods in a dress which requires $6\frac{1}{4}$ yards. Is it worth her time to look at $1.40 goods? What is the highest price material she can buy with this amount of money?

7. When a boy can buy a $3.00 pair of shoes for $2.50, what is the boy's per cent of saving and the merchant's per cent of reduction?

XIII

1. On January 2, 1919, a man borrowed $200, giving his note, bearing 6% interest, due June 2, 1921. How much money will it require to pay the note when due? Write the note supplying the necessary items.

2. Write a promissory note for $50 due in one year, bearing 5% interest, in which you are the borrower and your teacher is the lender.

3. How much will it require to settle a $100 6% note after running 18 months?

4. On Jan. 2, 1920, Roy Adams started a savings account with $10. On the first of each month thereafter for 5 months he added $10 to the account. If 3% interest was allowed, what was the account worth Jan. 1, 1921?

5. How much interest will a $4\frac{1}{4}$% $100 Liberty bond earn in $8\frac{1}{2}$ years?

6. A man bought 200 War Savings Stamps on July 1, 1920, when they cost $4.18 each. On January 1, 1925, our Government will pay him $1000 for these 200 stamps. How much more will the man receive than he would have received if he had invested the money for the same length of time at 3% interest?

7. Find the principal which at 6% earned $12 interest in 3 months.

8. The First Liberty Loan bonds issued in 1917 were sold on the following terms: 2% paid on application; 18% on June 28; 20% on July 30; 30% on August 15; and the balance on August 30. Find the amount of each payment on a $200 bond.

XIV

1. Find the cost of 5200 lb. of Carterville Lump coal at \$6.20 a ton. (1918 price.)

2. The purchase in problem 1 was paid in cash. Write the receipt for it, using your own name as buyer and that of some dealer in your vicinity as seller.

3. The man who wheeled the coal in problem 1 from the alley to the basement charged 2¢ a bu. How much did he get for the job, if there are 80 lb. in a bushel?

4. If a boy offers to scrub your schoolroom floor at 20 cents per 100 square feet, what will he get for it?

5. A manufacturing concern used during a certain month 1500 kilowatt hours of electricity. Compute the cost for the month, allowing 5% discount, if the rate is 8 cents per kilowatt hour for the first 500, 6 cents for the next 500, and 4 cents for anything over 1000 kilowatt hours.

6. Two boys bought a box of candy containing 60 sticks for 50¢. One paid 30¢; the other paid 20¢. How shall they divide the candy?

7. Mary Jones owns a \$100 $4\frac{1}{4}$% Third Liberty Loan bond due in 10 years from October 15, 1918. How much money does the bond earn each year? How much in 10 years? This bond was bought October 15, 1918.

8. If the girl named in the above problem invests in a 3% savings account the interest when paid, which is each April 15 and October 15, how much will the account be worth January 1, 1922?

HINT.—Remember that in savings accounts interest is not computed for a part of a dollar nor for a part of a month.

XV

1. Make a receipted statement for the following problem. For form see page 126. Supply name of firm and dates.

Mrs. Geo. Day during October, 1919, bought groceries as follows:

Saturday. 2 loaves of bread @ 10¢; $2\frac{1}{2}$ lb. butter @ 70¢; 1 lb. coffee 40¢; $2\frac{1}{4}$ lb. Wisconsin cream cheese @ 36¢; $1\frac{1}{2}$ doz. eggs @ 60¢.

Wednesday. 3 loaves of bread @ 10¢; 24 lb. flour @ 6¢; 4 lb. corn meal @ 6¢; 2 lb. barley flour @ $5\frac{1}{2}$¢.

Friday. 2 pecks of potatoes @ 37¢; 10 lb. Ben Davis apples @ 6¢; 3 bunches carrots @ 5¢; 2 heads cabbage weighing 4 lb. each at 4¢ per lb.

2. The following table shows two plans of buying groceries. Study it carefully, then find the value of all the question marks.

51st Official Fair Price List in Force Nov. 27, 1918 Commodity	Cost to Retailer	Cash and Carry Plan	Credit and Delivery Plan	Retailer's % of Gain by 1st Plan	Retailer's % of Gain by 2nd Plan	Cash Buyer's % of Saving
Irish potatoes, per lb.	$.02\frac{1}{4}$	$.03	$.03\frac{1}{4}$	$33\frac{1}{3}$%	44.4%	$8\frac{1}{3}$%
Sweet potatoes, per lb.	$.04\frac{1}{2}$	.06	$.06\frac{1}{2}$	?	?	?
Tub butter, per lb.	.68	.74	.75	?	?	?
Storage eggs, per doz.	.50	.57	.58	?	?	?
Flour, 24 lb. sack	1.39	1.56	1.59	?	?	?
Corn meal, per lb.	$.04\frac{1}{8}$	.05	$.05\frac{1}{4}$	?	?	?
Bacon, per lb.	.50	.56	.57	?	?	?
Dark corn sirup, 5 lb. can	.33	.40	.45	?	?	?
Navy beans, per lb.	.11	$.13\frac{3}{8}$	$.14\frac{3}{4}$	?	?	?
Lima beans, per lb.	.14	$.17\frac{1}{8}$	$.18\frac{1}{8}$	?	?	?

CHAPTER VI

PRACTICAL MEASUREMENTS

Learning to Estimate

1. Sometimes a skillful estimate of a distance is accurate enough. In sueh cases actual measuring is unnecessary. You can best get skill in estimating through correcting your estimates by actual measurement.

Schoolroom Estimates and Measurements

Name	Estimate	Measurement	Correction in Linear Units	in %
Window Pane Length Width				

2. On a sheet of paper of convenient size construct a blank table a part of which is shown above.

3. Estimate and place in the proper column of your table the length and width in inches of one of the window panes.

4. Make and record in the proper column the accurate measure of the dimensions of the pane.

5. Compute the correction in linear units and in %. Write so many inches long or short, so many % long or short, as the case may be.

6. Place in your table the estimate and measurement of each of the following:

1. The top of your desk in inches.
2. Your schoolroom floor in feet.

3. The cover of this book in inches.
4. The width of Indiana on the map on this page.
5. The window sash in feet and inches.
6. The schoolroom door in feet and inches.
7. The playground in rods.
8. The blackboard in feet and inches.

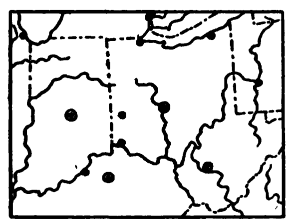
Drawing Distances to Scale

1. Draw the yard and the rod to scale representing 8 in. with one inch. What is the ratio of your long line to the short one?

2. A little boy to reach school had to walk 60 yards due east, then 50 yards due north, then 60 yards due west. Draw his path to scale. How far and in what direction was his stopping point from his starting point?

3. A certain English soldier was 6 ft. 1 in. tall. His cousin, an American soldier, was 5 ft. 10 in. Show the height of these soldiers by a convenient scale.

4. To reach a certain store from the school building one must walk 90 steps east and then 50 steps south. Draw the path to scale.



1 in. = 330 mi.

5. The map on this page is drawn to the scale 1 in. = 330 mi. What does this mean?

6. Using the scale, find the greatest length and width of Ohio; of Indiana.

7. Find the air line distance between Chicago and Columbus; between Chicago and Pittsburg; between Chicago and Cleveland; between Chicago and Indianapolis; between Cleveland and Louisville.

Changing Lengths to Smaller or Larger Units of Measure

In each of the following make the change indicated. Use pencil only when necessary.

1. 2 ft. 11 in. to inches; 2 yd. 2 ft. to feet.
2. 1 mi. 120 rd. to rods; 65 in. to feet and inches.
3. 20 ft. to yards and feet; $\frac{3}{4}$ mi. to rods.
4. 1760 yd. to mi.; 560 rd. to mi. and rd.

Problems about Lengths and Distances

1. One board is 10 ft. 6 in. long; another is 12 ft. 8 in. long; a third is 12 ft. 5 in. long. Find the total length of the 3 boards.

ft.	in.
10	6
12	8
12	5
35	7

The sum of the inches is 19.

19 in = 1 ft. 7 in. Write 7 below the line in the inch column.

Carry 1 to the next column.

Add. The sum is 35. Write in the proper place. The total length of the 3 boards is 35 ft. 7 in.

2. Find the perimeter of a room 12 ft. 9 in. long and 10 ft. 6 in. wide.

3. Find the perimeter of a schoolroom 40 ft. 3 in. long and 32 ft. 6 in. wide. Compare this with the perimeter of your schoolroom.

4. How far is it around a city lot whose sides are 35 ft. 6 in., 142 ft. 8 in., 34 ft. 10 in., and 141 ft. 9 in.?

5. Find the length in feet and inches of the dust trough at the bottom of your blackboard.

6. 8 rd. 9 ft. + 15 rd. 6 ft. + 24 rd. 7 ft. + 10 rd. 12 ft. = ?

7. 3 yd. 1 ft. + 2 yd. 2 ft. + 10 yd. 1 ft. + 4 yd. 1 ft. = ?

Everyday Problems

1. In a certain contest Frank jumped 13 ft. 2 in., and James jumped 11 ft. 8 in. Find the difference between the two distances.

13 ft.	2 in.	Since 8 is more than 2, think 8 from 14 (1 ft. 2 in.). Write 6 in.
11 ft.	8 in.	
1 ft.	6 in.	Think 12 from 13. Write 1 ft. The difference is 1 ft. 6 in.

Prove this work by adding the difference to the subtrahend.

2. A good standing broad jump record for a 6th grade girl is 5 ft. 6 inches; for a 6th grade boy it is 6 feet 6 inches. Compare these records with the best records of the girls and of the boys of your class.

3. The record baseball throw in a certain girls' college is 171 feet. How nearly can you equal this?

4. In a certain 100 yd. dash a boy lacked 3 yd. 1 ft. of reaching the goal. How far did he run?

5. Find the difference in inches between the tallest and shortest pupil in your class.

6. Find the difference between the length and width of your playground.

7. How many feet and inches does your schoolroom floor lack of being a square?

8. Peter is 4 ft. 9 in. tall. Francis is 5 ft. 2 in. tall. Find the difference in their heights.

9. Homing pigeon, U. S. A.—7917, in 1918 flew 56 mi. in 59 min. 10 sec. How many feet was that per second? Find the difference in speed per second in feet between an aeroplane flying 60 miles an hour and this pigeon.

Multiplying Lengths

1. Each side of a square playground measures 125 ft. 8 in. Find its perimeter.

SOLUTION.—Perimeter $=4\times125$ ft. 8 in.

PROCESS.—4×8 in. $=32$ in. or 2 ft. 8 in.
4×125 ft. $=500$ ft.
500 ft. $+2$ ft. $=502$ ft.

Perimeter $=502$ ft. 8 in.

2. Find the perimeter of a rectangular thrift garden 40 ft. 8 in. long and 18 ft. 9 in. wide.

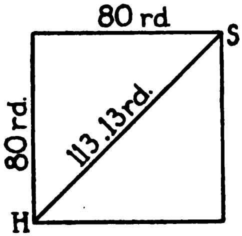
3. Find the length of the remnant after cutting 5 pieces of cloth each 2 yd. 2 ft. long from a piece 16 yd. long.

4. A square tennis court 40 ft. 8 in. long requires a fence on 3 sides. How many feet of fencing are needed?

5. Find the perimeter of a square each of whose sides is 15 yd. 2 ft.

6. How many feet of wire netting will it require to enclose a rectangular chicken yard 18 ft. 8 in. long, 10 ft. 9 in. wide?

7. How much picture molding will be required for a room 12 ft. 6 in. long and 10 ft. 8 in. wide? Find the cost at 10¢ per foot.



8. How many rods of walking does the boy whose home is shown in the figure at H save in a school month by going across the fields to school at S instead of by the roads? How many miles does he save in a school year of 10 mo. if there are 5 holidays?

1. Lucy divided a remnant of ribbon 5 ft. 9 in. long into 4 equal parts. Find the length of each part.

SOLUTION.—Length of each part = 5 ft. 9 in. ÷ 4.
PROCESS.—5 ft. ÷ 4 = 1 ft. and 1 ft. over.
1 ft. 9 in. = 21 in. 21 in. ÷ 4 = $5\frac{1}{4}$ in.
Length of each part = 1 ft. $5\frac{1}{4}$ in.

2. How many pieces of ribbon each 1 ft. 9 in. long can be cut from a piece 8 ft. 9 in. long?

HINT.—Reduce both dividend and divisor to inches.

3. A boy cut a board 15 ft. 8 in. long into 2 equal pieces. Find the length of each.

4. How many pieces each 1 ft. 2 in. long can be cut from a board 16 ft. long?

5. The perimeter of a square field is 162 rd. 7 ft. Find the length of one side.

6. How many carrot plants 4 inches apart are there in a row 10 ft. long?

7. How many 5 inch lengths can be cut out of a piece 1 yd. 2 ft. long?

8. Which use of division is employed in each of the problems from 1 to 7?

9. How many nails each $\frac{3}{4}$ in. long can be cut from a piece of wire 18 ft. 9 in. in length?

10. What is the average speed per hour when a train requires 3 hr. 20 min. to run 175 mi.?

11. Find the cost of 2 ft. 6 in. of silk at $2.88 a yard.

12. If it requires 5 ft. 8 in. of ribbon to make a sash for the sixth grade girls' party, how many such sashes can be made from 20 yards of ribbon? How much is left?

Angles

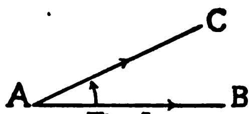


Fig. I

1. In the figure the two lines AB and AC have different directions.

2. The difference in the direction of these two lines is the angle BAC.

3. AC and AB are the sides of the angle.

4. A is the vertex of the angle.

5. An angle is sometimes read by naming the vertex only, as angle A in the figure.

6. An angle is also read by naming one side, then the vertex, and then the other side; as, angle BAC.

7. Draw, letter, and read five angles.

8. When a horizontal line meets a vertical line, a right angle is formed. See figure II. Angle CBA is a right angle.

Fig. II

9. How many more right angles can you draw, each having the vertex at B?

10. Angles are measured in units, called degrees (°). There are 90 such units in every right angle.

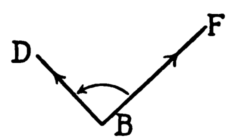


Fig. III

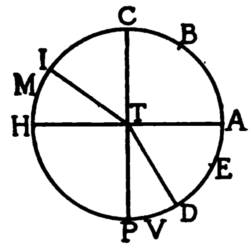
11. Draw a figure exactly like figure III. Cut out carefully and lay it on angle CBA, figure II.

12. The angle in figure III is also a right angle. Why?

Fig. IV

13. BAC in figure I is an acute angle, being less than a right angle.

14. Angle LMN (figure IV) is an obtuse angle because it is larger than a right angle.



1. A circle is a flat surface, every point of whose perimeter is equally distant from the center.

2. The entire perimeter or boundary line is called the circumference of the circle.

3. The distance from the center to the circumference is called the radius, as TA. The line through the center, which is twice the radius, is the diameter, as ATH.

4. Any portion of a circumference is called an arc of the circle. Name two large arcs in the figure; two small ones.

5. Arcs are measured in linear units (feet and inches) or in angle units, called degrees (°), minutes (′), and seconds (″).

6. An arc has as many degrees in it as there are degrees in the angle formed at the center of the circle by the two radii terminating the arc. In the figure, ABC is an arc of 90° because it is measured by the angle ATC, which is a right angle. Right angles are 90° angles.

7. In the figure read two right angles; two angles smaller than a right angle; two larger than a right angle.

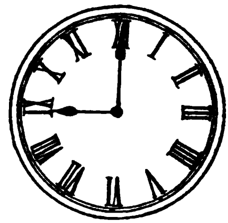
8. How many arcs of 90° each in a whole circumference?

9. How many degrees in a whole circumference?

10. Draw* a circle, and on its circumference lay off an arc of 45°; an arc of 135°; an arc of 180°; an arc of 270°.

* For drawing circles at the blackboard, use a piece of cord fastened to a crayon for a radius. How can you draw circles on a sheet of paper?

Problems about Angles and Arcs



1. Through how many degrees does the minute hand travel in one hour?

2. Through how many degrees does the hour hand travel in one hour?

3. How far does the second hand on a watch travel in one minute?

4. What angle does the minute hand make with the hour hand at 9 o'clock? At 4 o'clock? At 6 o'clock? At 3 o'clock? At 1 o'clock? At 5 o'clock? At 10 o'clock?

5. How long does it take for the hour hand to travel 360°? How far does it travel in one hour?

6. How many degrees in $\frac{1}{2}$ of a circumference? How many in $\frac{1}{6}$ of a circumference? How many in $\frac{1}{12}$ of a circumference?

7. Draw a circle, and on the circumference lay off what you think is an arc of 10°.

8. In the same circle lay off an arc of 90°.

9. Check your work in problem 7 by finding out how often you can lay off your 10° arc on the 90° arc.

10. What part is a 60° arc of a 90° arc of the same circle?

11. How often is a 45° arc contained in a 90° arc of the same circle? Prove your answer with a figure.

12. The distance around the earth on the equator is 25,000 miles. Through how many degrees has a man traveled after he has made 5000 miles of this distance?

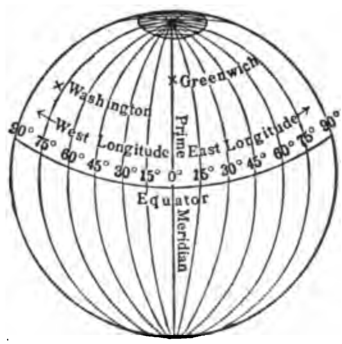
13. Did the man named in problem 12 travel through latitude or through longitude?

14. If the circumference of a circle is 20 feet, how many feet in a 90-degree arc of this circle? How long is an 18-degree arc of this circle?

15. The circumference of every circle, whether it be the boundary of a 25-cent piece or the equator of the earth, has 360° in it.

16. How does a degree of arc of a small circle differ from a degree of arc of a large circle?

17. If the equator of the earth is 25,000 mi., how long is one degree of arc on it?



18. What name did you give in geography to the curved lines on the earth having the same direction as the equator? What name to the lines crossing the equator at right angles?

19. Longitude is distance measured east or west of the prime meridian on curved lines called parallels.

20. Latitude is distance measured north or south of the equator on curved lines called ______________.

21. For the purpose of measuring very small angles and arcs a degree is divided into 60 equal parts called minutes (′), and a minute is divided into 60 equal parts called seconds (″).

Learn these facts.

360 degrees (°) = 1 circumference.
60 minutes (′) = 1 degree (°).
60 seconds (″) = 1 minute (′).

I—Rectangles

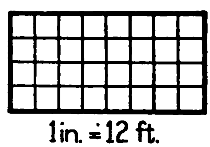
1. Name 6 units which you have used in measuring or computing areas.

2. Which of these units would be used in estimating (a) the surface of a window pane? (b) the area of your schoolroom floor? (c) the size of a farm in Ohio? (d) the area of Texas? (e) the amount of plastering in the ceiling of a room? (f) the area of a farmer's garden?

3. Without a ruler draw on the blackboard a square inch, a square foot, a square yard. Measure your figures and tell or write how much long or short you are on each dimension. In drawing squares which distance, the horizontal or the vertical, is harder to estimate?

4. Write from memory the table for surface measure. Check your work with the table in the back part of this book.

5. What is the area of an oblong 40 ft. by 20 ft.? Draw this oblong to scale and find the area of the figure you have drawn.

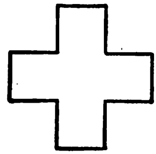


6. How many squares in this figure? What are the dimensions of each? Find the actual area of this figure. What are the dimensions of the oblong which it represents? What is the area of the oblong?

7. Find the area of a square 16.5 ft. on each side, the area of a square $5\frac{1}{2}$ yd. on each side. Draw these two figures to the same scale. Compare them.

8. How many acres in a square farm $\frac{1}{2}$ mi. to a side? Draw the farm to scale.

9. The square cross shown here is reduced from a 1919 Red Cross poster 10 inches by 6 inches.



$\frac{1}{4}$ in. $= \frac{7}{4}$ in.

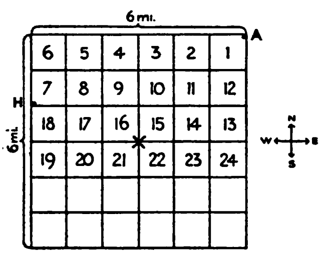
(1) Find the perimeter and area of the cross shown here.

(2) With the help of the scale find the perimeter and area of the cross represented by the figure.

(3) The cross is placed on a white surface 10 in. by 6 in. How much of this surface is not covered by the cross? What % of it is covered by the cross?

(4) The figure shown here is cut from a square $\frac{3}{4}$ inch to each side. What is the ratio of the part cut away to the figure? What % of the square remains in the figure?

The Township



This map represents a township divided into 36 sections. The numbers are the names of the sections. Section 1 is located in the northeast corner; section 36 in the southeast corner.

1. What are the dimensions of this township? What is the area in sq. mi.? In acres?

2. Compute the scale to which this map is drawn.

3. What are the dimensions of a section? What is the area in acres?

4. Locate section 30, section 26.

5. A man's farm is the southwest quarter of section 30.

Make a map of section 30, showing the farm. What is the shape of the farm? What are the dimensions? How many acres in it?

6. A man owns the north half of section 12. State the shape, dimensions, and area of this farm.

7. A man owns the south half of the northeast quarter of section 10. What fraction of a section does he own?

8. A man owning a section of land divided it into 4 equal square farms for his four children. What is the perimeter of each farm? How many rods of fence will be required to fence these farms? At 80¢ a rod what is the total cost of the fence? How much must each owner contribute?

9. In many townships in Iowa the roads follow the section lines. The township house is usually located at the center of the township. Find it on the map on page 269. What meetings are held in the township house?

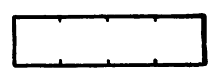
10. Following the road how many miles from the township house is Mr. A who lives at the northeast corner of section 1?

11. Mr. H lives at the southwest corner of section 7. How far is he from the township house? See the map on page 269.

12. Draw a rectangle twice as long as it is wide.

13. A rectangle is four times as long as wide. Its perimeter is 200 ft. Find its length and width.

HINT.—A study of the figure will help you to solve all problems similar to this one.



14. The perimeter of a rectangle three times as long as wide is 96 inches. Find the dimensions and the area.

II—Triangles

1. A triangle is a surface bounded by three straight lines, as ABC in figure I.

2. Draw, letter, and read 3 triangles with different shapes.

3. The vertex is the meeting point of any two sides of a triangle, as points A, B, and C in figures II and III.

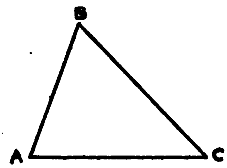


Fig. I.

4. The base is the side on which the triangle rests. See figures.

5. The altitude is the straight line drawn from the vertex, making a right angle with the base (figure II) or the base prolonged (figure III).

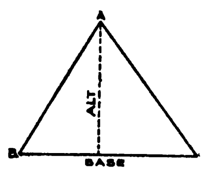


Fig. II.

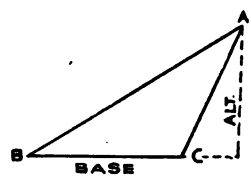


Fig. III.

6. With the book closed draw a triangle and show the 3 parts just defined.

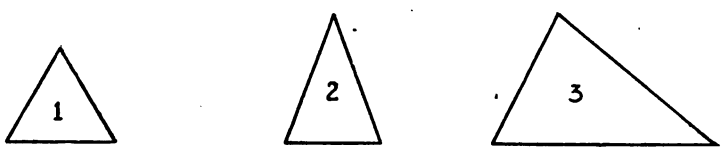


Fig. IV.

7. Triangles named from their sides are equilateral, isosceles, or scalene. Equilateral triangles have 3 sides equal; isosceles triangles have 2 sides equal; and scalene triangles have no sides equal. See the triangles in figure IV.

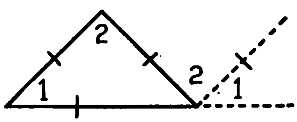
8. With book closed draw and name each of these triangles. Draw the altitude for each of your triangles.

9. See how many of these triangles you can find in your room, at home, or on your way to school.

10. Triangles named from their largest angle are called right, obtuse, or acute. Right triangles have one angle of 90 degrees; obtuse triangles have one angle larger than 90 degrees; acute triangles have all the angles less than 90 degrees. Draw these triangles.

The Angles of Triangles

1. The sum of the angles of a triangle is 180 degrees, or two right angles. See figure. Prove this by cutting two of the angles of a triangle and placing them as shown in the figure.



2. Why can a triangle have only one obtuse angle? Only one right angle?

3. A, B, C are the angles of a triangle.

(1) A = 80 degrees, B = 30 degrees. Find C. What kind of triangle is it?

(2) B = 90 degrees, A and C are equal. What kind of triangle? Draw it.

(3) A = 120 degrees, B = 40 degrees. Find C, and name the triangle.

(4) A = 60 degrees. Find B and C if they are equal. Name and draw the triangle.

(5) A = 40 degrees. Find B and C if they are equal. Draw the triangle.

4. Try to draw a triangle with two obtuse angles.

5. Try to draw a triangle with two right angles.

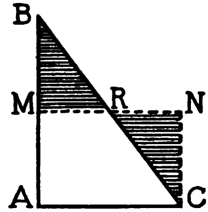
6. Draw a triangle with two acute angles. Name your triangle.

7. Remember every triangle has two names. See if you can give two names to each of the triangles you have drawn in problem 3.

Finding the Area of Triangles

(1) Right Triangles

1. What kind of triangle is shown in the figure? Why?



2. AC is called the base of triangle ABC. AB is called its altitude.

3. MN is equal to AC. It is drawn from M, the mid point of AB, making right angles at M with AB.

4. Name the figure MACN.

5. Copy the figure on a sheet of paper. Cut the triangle MBR on the line MR and place this triangle on triangle NRC. What have you discovered?

6. In the same manner any right triangle can be changed into a rectangle having the same area as that of the triangle.

7. Find the area of MACN if its length is 6 inches and its width is 4 inches.

8. Find the area of the triangle ABC if its base is 6 inches and its altitude is 8 inches.

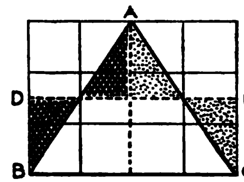
9. Draw the following right triangles and find the area of each.

(*a*) Base, 3 in.; altitude, 4 in. (*b*) Base, 12 in.; altitude, 16 in.
(*c*) Base, 6 ft.; altitude, 8 ft. (*d*) Base, 9 rd.; altitude, 12 rd.
(*e*) Base, 12 in.; altitude, 5 in.

10. Write a rule for finding the area of a right triangle.

(2) Other Triangles

Study the figure. Draw and letter one just like it. By cutting and fitting change your triangle into a rectangle as shown in the figure.



The base and $\frac{1}{2}$ the altitude of the triangle are the length and width of the rectangle.

The area of the triangle is the same as that of the rectangle, having for one side the base of the triangle and for the other side $\frac{1}{2}$ the altitude of the triangle.

1. Find the area of triangle ABC if its base is 12 in. and its altitude is 9 in.

2. Find the area of these triangles.

(*a*) Base 10 in.; altitude 7 in.
(*b*) Base 6 in.; altitude 5 in.
(*c*) Base 20 ft.; altitude 12 ft.
(*d*) Base 6 rd.; altitude 2 rd.

3. Find the area of each of the triangles below, making your solution show that the area of a triangle is equal to that of a rectangle whose width is $\frac{1}{2}$ the altitude of the triangle and whose length is the base of the triangle.

Thus in the triangle whose base is 12 ft. and altitude 8 ft., the area is 12 sq. ft.$\times\frac{8}{2}$. Draw the figure to show this.

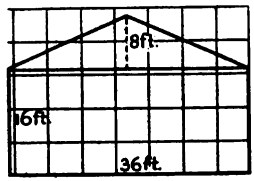
(1) Base is 18 inches, altitude is 6 inches. Find the area.

(2) Base is 3 yards, altitude is 2 yd. Find the area.

(3) Base is 10 feet, altitude is 4 ft. Find the area.

(4) Base is 6 ft., one side is 4 ft. The angle made by the base and this side is 90 degrees. Draw the triangle and find its area.

(5) What must you know about a triangle to find its area? Why do we need to know how to find the area of triangles?

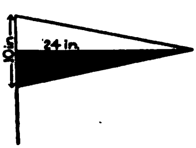


4. The figure represents one gable end of a barn 72 ft. long. The gable is the triangular part. What kind of triangle is it? To what scale is the figure drawn?

5. What is the area of the part shown in the figure? How many such areas are there in the barn?

6. The rectangular figure made by the length, 72 ft. (also written 72′) and the height in the clear, 16 ft., is called a side of the barn. Draw this figure to the same scale used for the gable end. How many such sides are there in the barn?

7. How many squares of painting (a square is 100 sq. ft.) are there in the total surface of the two sides and the two ends of the barn described in problems 4, 5, and 6?



8. This figure represents a little pennant made of a strip of orange felt and one of black felt. How many square inches of each color are required? How much felt must be purchased for 4 such pennants?

9. A class going to a foot ball game carried a pennant whose dimensions were 4 times those shown in the figure. How many square feet of felt were required to make it?

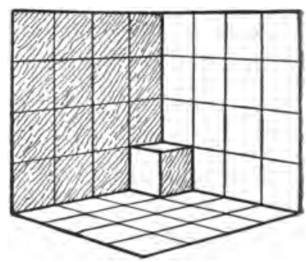
Measuring the Contents of Rectangular Solids

1. A rectangular solid has length, breadth, and thickness and six rectangular faces. What is a rectangle?

2. Find three rectangular solids in your schoolroom.

3. A rectangular solid with all its dimensions equal is a cube. How many and what kind of faces are there in a cube?

4. Write from memory the table for cubic measure. Check your answer with the help of the table in the back part of this book.



5. The figure on this page represents a box 4 in. long, 4 in. wide, and 4 in. high with two sides and the top removed.

(1) How many cubic inches in a row on the bottom of the box along the length?

(2) How many such rows are there in one layer?

(3) How many cubic inches (volume) in one layer?

(4) How many such layers are required to fill the box?

(5) How can you find the volume or cubical contents of the box?

The volume of a rectangular solid is the volume of one layer one unit thick multiplied by the number of such layers.

6. Measure 3 rectangular solids in your schoolroom. From your measurements compute their volume.

7. Compare the number of cubic feet of air space in your schoolroom per pupil with the standard, which is 200 cu. ft.

Volume, or capacity, may also be measured in such units as the gallon, the bushel, or the ton.

Use these facts when needed in solving practical problems about capacity.

231 cu. in. = 1 gal.	1 cu. ft. = .8 bu.
$7\frac{1}{2}$ gal. = 1 cu. ft.	1 cu. ft. = .43 bu. of ear corn
$34\frac{1}{2}$ cu. ft. = 1 ton hard coal	1 cu. ft. = .63 heaped bu.
38 cu. ft. = 1 ton soft coal	

1. How many gallons of water in a rectangular aquarium 30 in. long, 15 in. wide, and 22 in. deep when $\frac{2}{3}$ full? Use cancellation.

2. How many bushels of wheat are there in a box 12 ft. long, 4 ft. wide, and 3 ft. 8 in. deep?

3. A potato bin is 6 ft. by 4 ft. by 4 ft. How many bushels will it hold? Potatoes are measured by the heaped bushel.

4. A farmer built a corn crib 24 ft. long, 6 ft. wide, and 10 ft. high. How many bushels of ear corn will it hold?

5. How many quarts of chicken feed in a box 24 in. by 12 in. by 8 in.?

6. If a wagon box is $10\frac{1}{2}$ ft. by 40 in. by 30 in., how many bushels of wheat will it hold? How many bushels of potatoes? How many of ear corn?

7. A boy by measuring a rectangular coal pile found its dimensions to be 24 ft., $15\frac{1}{2}$ ft., and $4\frac{1}{2}$ ft. How many tons of soft coal are there in such a pile? How many of hard coal?

8. Find the dimensions of the coal bin at home or at school and compute its capacity in tons.

Finding Averages and Medians

1. If Frank weighs 62 lb. and Fred weighs 78 lb., what is their average weight?

HINT.—The average of any set of numbers is the sum of the set divided by the number of numbers in the set.

$$\text{The average weight of the 2 boys} = \frac{62 \text{ lb.} + 78 \text{ lb.}}{2}.$$

$$\text{The average weight of the 2 boys} = \frac{140 \text{ lb.}}{2} = 70 \text{ lb.}$$

2. Find the average age of 3 girls whose ages in years are 10, 12, and 15.

3. Find Mary's average in arithmetic for the week if her daily grades were 70, 75, 80, 70, 85.

4. The median is the middle number in a series arranged in ascending or descending order. In the series 2, 3, 7, 8, 9, the median is 7.

5. In stating the standing of a class it is better to use the median than the average. The median tells the quality of the class. It tells how many are above and below the middle of the class. An average does not show this.

6. The following record of a small arithmetic class in a test shows the difference between the median and the average. Record: 20%, 60%, 65%, 80%, 85%, 86%, 90%. The median is 80%. This means 4 of the 7 members of the class had a mark of 80 or better, which is a good record. The average is $69\frac{3}{7}$%, which is only a fair record. Which mark shows the quality of the class?

7. In the following score find the average and the median: 50, 60, 63, 64, 72, 75, 95.

8. Where the achievement of a class is to be shown, the median should always be used.

9. John solved 11, 12, and 16 problems in each of 3 hours. What is his average per hour?

10. Find the median in the following series: 55, 57, 63, 66, 69, 70, 79, 84, 87.

11. Three watermelons weigh 18, 22, and 27 lb. Find the average weight. Which is the median melon?

12. Find the median achievement of your class in the last arithmetic test.

13. Find the average weight of your football team.

14. Which of these three lines is the median? Find the average of the three and draw it. Compare it with the median.

(1)

(2)

(3)

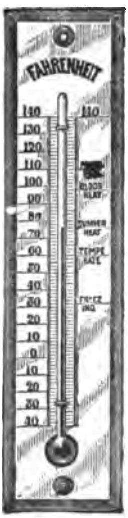
15. Make and solve 5 problems in which you need to find the average; 5 in which you need to find the median.

16. In a football team with 11 regular and 5 substitute players, the weights of the men are as follows: 163, 220, 180, 152, 175, 190, 184, 176, 159, 171, 164, 148, 168, 196, 182, and 195 pounds. Which is the median? What is the average? What is the average weight of a team formed by selecting the eleven heaviest of these men? What is the average by selecting the eleven lightest?

17. The average weight of 11 football players beginning a game is 162 pounds. How will this average be affected by taking out three men weighing respectively 140, 142, and 146 lb. and substituting three men weighing 160, 180, 185 lb.? Give answer in lb. and in per cent.

Measuring Temperature

The thermometer most commonly used was invented about 200 years ago by a German, named Fahrenheit, hence the name Fahrenheit thermometer. He put a tube with a bulb at one end, filled with mercury, into melting ice and marked the top of the mercury column. This he called 32°, or the Freezing Point. Then he put the tube into boiling water and marked the top of the mercury column. This he called 212°, or the Boiling Point.



1. How many degrees are there between the Boiling Point and the Freezing Point? How many between the Freezing Point and Zero?

2. What happens to the mercury column on a hot day?

At what point does it usually stand in your schoolroom?

3. Read the thermometer. Then place your fingers on the bulb for two minutes. Through how many degrees did the mercury move?

4. Temperature above zero is shown by the plus sign (+); below zero is shown by the minus sign (—).

5. State first whether the temperature rose or fell, then state the number of degrees.

	a	b	c
(1)	+18° to +40°	+74° to +68°	−4° to +6°
(2)	0° to +14°	0° to − 8°	+6° to −6°
(3)	−10° to +12°	− 8° to − 6°	−2° to −4°

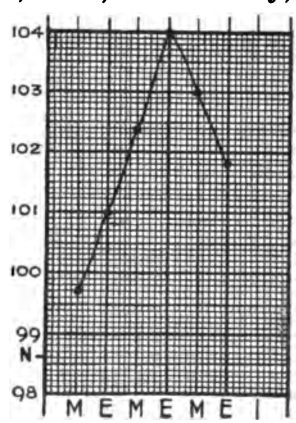
1. Compare the thermometer on this page with the one on page 280. Both are Fahrenheit thermometers. How do they differ?

2. The thermometer shown on this page is used by doctors and nurses. When a person is well, his temperature is said to be normal and will register about 98.6°, marked N on the thermometer.

3. In case of fever, the body temperature is above normal; in case of chill, the temperature is below normal.

4. How much below normal is a temperature of 97.8°? How much above normal is a temperature of 102.3°?

5. Susan's morning and evening temperature for 3 days during an attack of influenza was as follows: first day, 99.6°, 101°; second day, 102.4°, 104°; third day, 103°, 101.8°. The above record was placed on a sheet called a temperature chart. Each vertical space on the chart stands for .1°. Each horizontal 10 spaces stand for 24 hours, divided into two parts, M and E, morning and evening.



6. Susan's temperature for the next three days was as follows: 101°, 100.5°; 100°, 99.8°; 99°, 98.6°. Study the chart on page 281, then complete it for the last three days.

7. The following table shows a part of the weather record in a certain city for March 8, 1919. Read the record.

1 A. M.	42°	7 A. M.	39°
2 A. M.	42°	8 A. M.	39°
3 A. M.	41°	9 A. M.	39°
4 A. M.	40°	10 A. M.	40°
5 A. M.	40°	11 A. M.	40°
6 A. M.	39°	12 M.	41°

8. What was the highest temperature shown in the above table? What was the lowest?

9. What is the average temperature in problem 7?

10. Make a chart showing the temperature changes in problem 7.

11. Make an hourly temperature chart of your schoolroom from 9 A. M. to 3 P. M. of the day on which you study this page. Find the average temperature for this period.

12. The temperature in a certain schoolroom at 8 A. M. for 5 successive mornings was 50°, 54°, 52°, 58°, 60°. Find the average.

13. Record for one day the temperature at the end of every hour from 8 A. M. to 4 P. M. Find the average. What is the median?

Making and Solving Problems about Your Schoolroom

1. Make a map of your schoolroom to a convenient scale, showing the position of the door, the desks, and the windows.

2. What is the perimeter in feet? In yards? In rods?

3. Find the cubical contents; also the air space per pupil.

4. Find the area of the floor in square feet; in square yards; in square rods.

5. What is the floor space per pupil? The standard is 15 sq. ft.

6. Find the entire lighting surface; the lighting surface per pupil. The standard is $2\frac{1}{2}$ sq. ft. to 4 sq. ft.

7. How much blackboard surface per pupil is in your schoolroom?

8. Find the average attendance for one week.

9. Who has the better per cent of attendance for three successive days, the boys or the girls?

10. Find the value of all the desks in the room.

11. Compute the probable cost when new of all the texts used.

12. What per cent yearly should be allowed for the wear and tear on the arithmetics?

13. Estimate the cost of the stationery (ink, paper, pencils, pens) per pupil for a school year.

14. What is the average height of the boys in your class? Of the girls?

15. Find the average age of the class in years and months at the time you are working on this page. Express the age of each pupil as so many years and months.

Problems

1. How many cubic feet in a box 8.4 ft. by 4.5 ft. by 3.75 ft.?

2. A tank is 12 ft. 9 in. long, 8 ft. 6 in. wide, and 5 ft. 3 in. deep. How many gallons of water in it when $\frac{1}{2}$ full allowing 7.5 gallons to the cubic foot?

3. How many cubic feet of air space in a room 42.6 ft. long, 34 ft. 6 in. wide, and 15.8 ft. high?

4. What is the ratio of .75 yd. to .75 ft.?

5. A certain city lot rectangular in shape is 142 ft. 6 in. long, and 32 ft. 9 in. wide. Find the area in square feet.

HINT.—Which is easier, $142\frac{1}{2} \times 32\frac{3}{4}$ or 142.5×32.75?

6. How deep must I make a tank 8 ft. by 4 ft. to hold 750 gallons? ($7\frac{1}{2}$ gal. = 1 cu. ft.) Carry the result to three decimal places.

7. An airplane flew 120 mi. in 1 hr. 30 min. How far was that in one hour? How far in 1 minute?

8. Find the area in sq. ft. of a table top 4 ft. 6 in. by 2.5 ft.

9. How many square flower beds, each 7 ft. $\times$ 7 ft., can be laid off on an oblong 63 ft. long and 56 feet wide?

HINT.—How many such beds are there along the length? How many rows of beds in the width?

10. How many square beds, each 8 ft. by 8 ft., can be placed in an oblong 75 feet long and 58 feet wide? How many square feet remain?

11. From a rectangular cardboard, 18 in. $\times$ 12 in., cut the largest possible number of cards, each 4 in. by 3 in. Draw both figures.

12. At Boise, Idaho, the rainfall in inches by months for a certain year was as follows: 1.6, 1.2, 1.6, 1.4, 1.6, 1.0, .5, .4, .7, 1.0, 1.3, and 1.3. What was the total rainfall? What was the average monthly rainfall?

13. Artificial ice is commonly made in blocks whose dimensions are 40 in. $\times$ 22 in. $\times$ 11 in. If such a cake weighs 320 lb., what is the weight of a cubic foot? How many pounds heavier is a cubic foot of water (weight $62\frac{1}{2}$ lb.) than a cubic foot of ice? What would happen to lakes and ponds if ice were heavier than water?

14. How can you find the area of your schoolroom ceiling without measuring its dimensions?

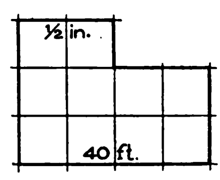
15. Make a comparison of the length, width, and height of your schoolroom by drawing three lines to a suitable scale.

16. A boy said he drew a map of the school yard on a scale of 1 to 300. What did he mean?

17. If you drew a map of a section of land on a scale of 1 to 5280, how long and wide would your map be?

18. A man owning a quarter section of land in the form of a square wished to map it to the largest and most convenient scale on a sheet of paper 9 in. by 12 in. What is the probable size of his map? What is the scale?

19. The figure on the right is the ground plan for a building with a basement. Determine the scale if the longest line is 40 ft. How many loads (cubic yards) of earth were removed if the excavation is 6 feet deep?



CHAPTER VII

EXERCISES FOR SPEED AND ACCURACY

I

Speed Test in Adding

A 6th grade pupil should have 8 right in 8 min.

234	783	134	215	245	864
979	420	979	787	306	977
567	828	305	478	498	590
478	539	887	196	589	745
754	354	260	509	250	839
992	196	456	924	615	986
366	217	392	840	824	692
439	604	910	382	707	548
329	975	129	623	191	704

319	932	577	205	586	170
985	749	194	110	324	676
758	288	538	324	247	505
264	539	636	638	174	237
437	672	860	411	958	458
801	416	575	539	435	722
126	284	751	747	913	384
598	219	402	156	692	899
677	704	389	200	709	968

II

Speed Test in Long Division

A 6th grade pupil should solve 8 right in 8 min.

88)50336	72)15264	39)15210	43)29283
63)58275	82)35424	19)10146	27)15660

III

Speed Test in Subtraction

A 6th grade pupil should have 10 right in 4 min.

68763082	83512809	53280048	46328730
30168949	57494057	48912372	21563417
140175021	115728308	124241637	71014301
63625712	96460464	37912642	36951074
165431165	121430759	46131804	14968150
73238205	56209865	29702952	9327202

IV

Speed Test in Multiplication

After copying these multiplication examples, a good sixth grader should do 9 right in 6 minutes.

5624	9389	9158	3528	6809
18	79	42	35	69
9807	5369	3279	5486	6942
91	28	54	76	430

V

Find in one minute the per cent of games won by each of the following girls' teams in basket ball.

	Won	Lost		Won	Lost
Wyman	8	1	Belleville	8	4
Mann	10	2	Charleston	6	5
Sherman	6	3	Mattoon	7	3

VI

Using Zero in Computing

I

Practice on these until you can tell the right answer for all in one minute.

	a	b	c
1.	$3+0=?$	$0\times 0=?$	$5-0=?$
2.	$6\times ?=0$	$0\times 8=?$	$0+7=?$
3.	$0\div 6\frac{1}{2}=?$	$\frac{3}{4}\times 0=?$	$60\div 30=?$
4.	$100\div 20=?$	$0\times 1.8=?$	$0\div\frac{1}{4}=?$
5.	$?+6=6$	$8-?=8$	$60\times 3=?$
6.	$10\times 20=?$	$10\div\frac{1}{2}=?$	$\frac{3}{4}\times 20=?$
7.	$20\times 0=?$	$80-60=?$	$90\times 10=?$

II

Find these products in 10 min.

	a	b	c
1.	$406\times 22=?$	$302\times 240=?$	$\$\ .04\times 640=?$
2.	$550\times 36=?$	$750\times 308=?$	$\$0.60\times 45=?$
3.	$842\times 40=?$	$40\%\times 125=?$	$\$3.45\times 45\%=?$
4.	$300\times 20=?$	$85\%\times 210=?$	$\$6.10\times 50\%=?$

III

How long does it take you to solve and prove these examples? Try again tomorrow.

	a	b	c
1.	$12\overline{)24060}$	$.12\overline{)240.60}$	$64\overline{)64002}$
2.	$30\overline{)54690}$	$.3\overline{)54.696}$	$36\overline{)72036}$
3.	$24\overline{)78040}$	$2.4\overline{)780.48}$	$25\overline{)48000}$

VII

The Stone Test in the fundamental processes

This test was given to 6000 6th grade pupils in 1907.

Solve as many as you can in 12 min. Then use 12 min. in checking your work. Try to improve your record.

1. Add
   2375
   4052
   6354
   260
   5041
   1543

2. Multiply 3265 by 20.
3. Divide 3328 by 64.
4. Add
   596
   428
   94
   75
   302
   645
   984
   897

5. Multiply 768 by 604.
6. Divide 1918962 by 543.
7. Add
   4695
   872
   7948
   6786
   567
   858
   9447
   7499

8. Multiply 976 by 87.
9. Divide 2782542 by 679.
10. Multiply 5489 by 9876.
11. Divide 5099941 by 749.
12. Multiply 876 by 79.
13. Divide 62693256 by 859.
14. Multiply 96879 by 896.

VIII

All right in 6 min. after copying the examples. Prove your work by division.

	a	b	c
1.	$3.4 \times 2.56 = ?$	$.35 \times 128 = ?$	$.54 \times 863 = ?$
2.	$68 \times 57.8 = ?$	$7.5 \times 3.45 = ?$	$25 \times 7.62 = ?$
3.	$3.5 \times .605 = ?$	$96 \times .048 = ?$	$1.6 \times 14.4 = ?$

IX

Saving time in multiplying

Find these results by cancellation. Remove large common factors.

	a	b
1.	$\frac{36\times27\times24}{9\times4\times6}=?$	$\frac{25\times16\times7}{14\times12}=?$
2.	$\frac{18\times19\times17}{85\times57}=?$	$\frac{17\times18\times19\times15}{85\times90}=?$
3.	$\frac{12\times15\times18}{72\times8}=?$	$\frac{16\times21\times24}{14\times72}=?$
4.	$\frac{68\times72\times99}{24\times17\times11}=?$	$\frac{18\times27\times36}{81\times54}=?$
5.	$\frac{13\times15\times12}{78\times60}=?$	$\frac{24\times36\times45}{360}=?$
6.	$\frac{75\times8\times120}{25\times15}=?$	$\frac{360\times720\times5}{24\times15\times45}=?$

X

Business men make change by the adding method.

Amt. of Purchase	Amt. Given	Amt. of Change	No. of Pieces
1. $3.57	$4.00	(3¢ + 5¢ + 10¢ + 25¢)	6
2. .33	1.00	?	?
3. 1.52	5.00	?	?
4. .15	.50	?	?
5. .23	5.00	?	?
6. 2.52	3.00	?	?
7. .96	10.00	?	?
8. .87	1.00	?	?

XI

Find out how long it takes you to solve all of these multiplication examples. Exchange your work with a classmate for correction.

	a	b	c
1.	$3.4 \times 6.5 = ?$	$.68 \times .75 = ?$	$4 \times .96 = ?$
2.	$.04 \times 9.6 = ?$	$.025 \times .25 = ?$	$.4 \times .08 = ?$
3.	$.07 \times .008 = ?$	$64 \times .64 = ?$	$12.5 \times 125 = ?$
4.	$13.5 \times 1.35 = ?$	$75 \times 75 = ?$	$.65 \times 65 = ?$
5.	$6.5 \times .650 = ?$	$23.5 \times 2.5 = ?$	$34 \times .034 = ?$
6.	$88.2 \times .81 = ?$	$3.45 \times .09 = ?$	$.03 \times 500 = ?$
7.	$3004 \times .004 = ?$	$3.1416 \times 40 = ?$	$.26 \times 3.75 = ?$
8.	$.01 \times .001 = ?$	$100 \times .0001 = ?$	$.002 \times 2000 = ?$

XII

Find out how long it takes you to solve and prove all of these division examples.

	a	b	c	d
1.	$12\overline{)12}$	$12\overline{).12}$	$.001\overline{).01}$	$.1\overline{)10}$
2.	$25\overline{)75}$	$.25\overline{)75}$	$840\overline{)84}$	$8.4\overline{)84}$
3.	$21\overline{).84}$	$81\overline{)3.24}$	$.021\overline{).84}$	$\frac{1}{3}\overline{)3}$
4.	$.3\overline{)3}$	$.03\overline{)30}$	$.3\overline{).30}$	$1.2\overline{)2.4}$
5.	$2.4\overline{)1.2}$	$.24\overline{).12}$	$2.4\overline{).12}$	$9\overline{).036}$
6.	$.9\overline{)0.36}$	$90\overline{)36}$	$150\overline{)15}$	$2.7\overline{)27}$
7.	$40\overline{)4}$	$.04\overline{).4}$	$.4\overline{)40}$	$.25\overline{)100}$
8.	$.25\overline{)800}$	$50\overline{)250}$	$250\overline{)50}$	$64\overline{)16}$
9.	$.7\overline{)3.5}$	$.9\overline{)45}$	$.9\overline{)4.5}$	$.1\overline{).02}$
10.	$.7\overline{)56}$	$.14\overline{).7}$	$25\overline{)2.5}$	$.25\overline{)25}$

XIII

Write the answers without the use of side work if possible. Time yourself. If you miss more than 5, try again tomorrow.

1. $53.1-3.531=$
2. $9.5\div.5=$
3. $79.42\div.02=$
4. $.749\times1.07=$
5. $14.301-4.203=$
6. $1.209\times807=$
7. $.705\times2.03=$
8. $5.544\div1.8=$
9. $9.28\times.076=$
10. $80.855-78.5=$
11. $7.68-2.105=$
12. $6.25\div2.5=$
13. $56.25\div7.5=$
14. $17.28\div1.44=$
15. $30-2.084=$
16. $.2\times.3\times600=$
17. $20.02+1.1+.016=$
18. $.3+3+2000+.084=$
19. $5.006+81.29+264.5=$
20. $25.03+101.105+8.8=$
21. $(15\div.1)+(30\div.25)=$
22. $(36\div1.8)-(20\div25)=$
23. $72.683+2.946=$
24. $25\%+.33+62\%=$
25. $\frac{3}{4}+\frac{5}{8}-12\frac{1}{2}\%=$
26. $.625+.25+\frac{1}{8}=$
27. $.02\%+25\%+3.5\%=$
28. $15\frac{3}{5}+18.4+37=$
29. $125+375-240=$
30. $5.42+4.8+6.4=$
31. $3012.04-124.183=$
32. $400\div.66\frac{2}{3}=$

XIV

In this 3-minute test given to sixth grade classes, the median score for rights was 4.1. Find the median for your class.

1. $\frac{3}{4}+\frac{1}{6}=$
2. $\frac{3}{4}\div\frac{1}{8}=$
3. $\frac{5}{8}\times\frac{16}{24}=$
4. $\frac{5}{8}-\frac{3}{16}=$
5. $\frac{5}{8}-\frac{5}{12}=$
6. $\frac{5}{6}+\frac{3}{8}=$
7. $\frac{2}{3}\div\frac{5}{12}=$
8. $\frac{3}{4}\times\frac{20}{32}=$
9. $\frac{2}{3}\times\frac{3}{4}=$
10. $\frac{7}{8}-\frac{3}{4}=$
11. $\frac{11}{12}+\frac{2}{3}=$
12. $\frac{3}{8}\div\frac{3}{16}=$

XIV

Name the missing numbers where the dots are.

	a	b
1.	$10 = \frac{1}{4}$ of ...	$6 = \ldots$ of 24
2.	$\frac{3}{4}$ of $24 = \ldots$	$9 = \ldots$ of 12
3.	8 is $\frac{2}{3}$ of ...	$8 = \ldots\%$ of 50
4.	$\frac{3}{4} \times 48 = \ldots$	$12 = \ldots\%$ of 48
5.	$3\frac{1}{3} \times 12 = \ldots$	$12\frac{1}{2} = 50\%$ of ...

XV

A percentage test

There are 25 examples in this exercise. See how many correct answers you can write in 10 min.

	a	b
1.	10% of $2.50 = ?	15% of $3.00 = ?
2.	2% of $250 = ?	$2\frac{1}{2}\%$ of $200 = ?
3.	25% of 40¢ = ?	25% of $40 = ?
4.	$33\frac{1}{3}\%$ of 12 ft. = ?	$12\frac{1}{2}\%$ of 80 A. = ?
5.	$6 is what % of $18?	What part is $3 of $4?
6.	2¢ is what % of 20¢?	What part is 5¢ of $1.00?
7.	$5 is what % of $15?	2 ft. is what % of 4 ft.?
8.	3 ft. is what % of a yd.?	4 pk. is what % of a bu.?
9.	$4 + 5% of $4 = ?	$10 + 20% of $10 = ?
10.	$12 − $12\frac{1}{2}\%$ of $12 = ?	$24 − $66\frac{2}{3}\%$ of $24 = ?

11. 8 out of 10 right is what % right?
12. 3 out of 10 wrong is what % right?
13. $200 + int. on $200 for $1\frac{1}{2}$ yr. at 6% = ?
14. $300 + int. on $300 for 2 mo. at 6% = ?
15. $400 + int. on $400 for 1 yr. 1 mo. 15 da. at 6% = ?

XVI

Solving problems by telling how

Write your answer in **Good English.**

1. What is an easy way of adding 19, or 29, or 39, etc., to a number?

2. How do you subtract 19, or 29, or 39, etc., from a number?

3. What is the short way of multiplying a number by 25?

4. How do you divide a sum of money by $12\frac{1}{2}$¢; by $33\frac{1}{3}$¢; by 75¢?

5. How can you find quickly the following per cents of a number: 20%, 25%, $12\frac{1}{2}$%, $8\frac{1}{3}$%, $33\frac{1}{3}$%, 50%, 125%, $133\frac{1}{3}$%?

6. How do you divide an integer by a common fraction?

7. How do you divide one decimal fraction by another?

8. How may you know without dividing whether 9 is a factor of a certain large number? What is the divisibility test for 8? for 6? for 4? for 3?

9. If the denominators of two fractions are the same and the numerators are different, which is the larger fraction? Why?

10. If the numerators of two fractions are the same and the denominators are different, which is the larger fraction?

11. In what two ways can you multiply a given fraction, such as $\frac{3}{8}$, by 4?

12. How do you divide one common fraction by another?

XVII

1. Compare an oblong 3 inches by 1 inch with a 3-inch square as to perimeter and area.

2. Compare in the same manner an oblong 12 in. by 1 in. with a 12-inch square. What is another name for the 12-inch square?

3. Draw an oblong 18 ft. by 12 ft. to scale. Find the perimeter and area in yards and square yards. Find the perimeter and area of your figure.

4. Find the ratio of a 2-inch square to 2 sq. in.

5. Find the ratio of a 2-inch cube to 2 cu. in.

6. After cutting a 2-inch cube out of the corner of a 4-inch cube, what fractional part of the large cube remains?

7. What is the surface in square feet of the faces of a 12-inch cube?

8. If a cubic foot of water weighs $62\frac{1}{2}$ lb., how much will a 2-foot cube weigh?

9. Which is heavier, a cubic foot of ice or a cubic foot of water? How may you know without weighing the ice?

10. Compare the length, surface, and volume of a 4-foot cube with that of a cubic yard.

11. What part of a cubic foot is a 6-inch cube?

12. Find the cost of making a walk 6 feet wide in front of a 50-foot lot at $12\frac{1}{2}$¢ a square foot.

13. What is the cost of paving a street 50 feet wide and $\frac{3}{4}$ mile long at $1.25 per square yard?

14. How high must a rectangular bin whose base is 8 ft. by 12 ft. be to hold 12 tons of soft coal, if you count 38 cu. ft. to the ton?

XVIII

Solving problems without figuring

1. If you know the per cent of each member of your class in a test in addition, how can you find the class average? How can you find the class median?

2. If you know how long a sum of money has been loaned and the rate of interest, how do you find the interest?

3. If you know how much a certain sum of money earns in a given time, how can you find the amount earned in one year? How find the rate of interest?

4. How do you express a given per cent as a common fraction?

5. If you know how many examples Susan has right in a test and how many in the test, how do you find her mark?

6. Given the regular price and the % of reduction, how can you find the % of saving?

7. Given the cost and loss of an article, how can you find the selling price?

8. If you know the amount of your savings deposit Jan. 1, 1920, the amount deposited on the 25th of each month, and the rate of interest, how can you find the value of the account July 1, 1920?

9. If you know the scale to which the map of Iowa is drawn, how do you find the greatest length and width of the state in miles?

10. If you know the temperature for each hour from 9 A. M. till 3 P. M., how do you find the average?

XIX

Write the answer to each question in good English.

1. If you know John's grade in each of his studies, how do you find his average grade?

2. A fruit dealer bought a stalk of bananas, containing a certain number of dozens, at a certain price. How would you find the cost per dozen?

3. A traveler made a trip of a given number of miles, going a certain number by train and the rest by automobile. How would you find the distance traveled by auto?

4. A grocer bought apples by the barrel and sold them by the peck. How do you find his gain on a peck?

5. If you know how tall a boy is now, how high he grew this year, and how high last year, how would you find his height at the beginning of last year?

6. If you know the cost of all my purchases in a store and the amount of my change, how would you find out the amount of money I handed to the clerks?

7. If you know how many pupils are in your room each school day of the week, how can you find the average daily attendance?

8. If you know the cost of a baseball suit and of a pair of shoes, how would you find the total cost of furnishing a baseball nine with suits and shoes?

9. A boy earned a given sum last week. He gave a certain amount of this sum to his mother and invested the rest in thrift stamps. How would you find out how many thrift stamps he could buy?

XX

Project problems

1. Lamb's quarters is a common garden weed. In a recent year some 6th grade children of the Field School cultivated such a plant to see how many seeds it would produce under good garden conditions. They found that all the seed weighed 8 oz. and that each ounce contained 75,000 seeds by count. If one in 1000 of these seeds should grow into mature plants the next season and each plant produce .001 of the number of seeds found on the Field School plant, how many seeds would there be in this crop? What would be the weight of this weed seed crop?

2. A farmer raised 10 acres of potatoes. He used 12 bushels worth $1.50 per bu. for planting each acre. The materials for spraying cost $1.60 per acre. The labor (one man and team) for plowing, harrowing, planting, cultivating, spraying, digging, and hauling to market required 45 hr. per acre, valued at 75¢ per hour. The cost of picking up and sacking was $2.50 per acre. The field yielded 110 bushels per acre worth $1.25 a bushel.

(1) What was the total cost of the seed potatoes used for planting?

(2) What was the cost of the spraying materials?

(3) What was the entire labor cost including the picking up and sacking?

(4) How much did the farmer get for his potato crop?

XXI

The Rice test

The following is the Rice test given in 1902 to 1285 sixth grade children. The average achievement (right answers) for the best class was 79.3%; for the poorest class it was 32.1%; the average for all the sixth grade classes was 69.4%.

Try to solve this list in 50 minutes.

Can you make 70% on this test?

1. If a boy pays $2.83 for a hundred papers and sells them at 4 cents apiece, how much does he make?

2. What will 24 quarts of cream cost at $1.20 a gallon?

3. If I buy 8 dozen pencils at 37 cents a dozen and sell them at 5 cents apiece, how much do I make?

4. A flour merchant bought 1437 barrels of flour at $7 a barrel. He sold 900 of these barrels at $9 a barrel and the remainder at $6 a barrel. How much did he make?

5. If a train runs $31\frac{2}{3}$ miles an hour, how long will it take it to run from Buffalo to Omaha, a distance of 1045 miles?

6. If a map 10 inches wide and 16 inches long is made on a scale of 50 miles to the inch, what is the area in square miles that the map represents?

7. The salt water which was obtained from the bottom of a mine of rock salt was .08 of its weight pure salt. What weight of salt water was it necessary to evaporate in order to obtain 3896 pounds of salt?

XXII

The Stone problem solving test

Mr. Stone gave this test in 1906 to 6000 sixth grade children. See how many of these problems you can solve in 15 min. After the test solve those you did not try.

1. If you buy 2 tablets at 7¢ each and a book for 65¢, how much change should you receive from a two-dollar bill?

2. John sold 4 *Saturday Evening Posts* at 5¢ each. He kept $\frac{1}{2}$ the money and with the other $\frac{1}{2}$ he bought Sunday papers at 2¢ each. How many did he buy?

3. If James had 4 times as much money as George, he would have $16. How much money has George?

4. How many pencils can you buy for 50¢ at the rate of 2 for 5¢?

5. The uniforms for a baseball nine cost $2.50 each. The shoes cost $2.00 a pair. What was the total cost of uniforms and shoes for the nine?

6. In the schools of a certain city there are 2200 pupils; $\frac{1}{2}$ are in the primary grades, $\frac{1}{4}$ in the grammar grades, $\frac{1}{8}$ in the high school, and the rest in the night school. How many pupils are there in the night school?

7. If $3\frac{1}{2}$ tons of coal cost $21, what will $5\frac{1}{2}$ tons cost?

8. A newsdealer bought some magazines for $1. He sold them for $1.20, gaining 5 cents on each magazine. How many magazines were there?

9. A girl spent $\frac{1}{8}$ of her money for carfare, and three times as much for clothes. Half of what she had left was 80 cents. How much money did she have at first?

Tables of Common Measures

Length

12 inches (in. or ″)	= 1 foot (ft. or ′)
3 feet	= 1 yard (yd.)
$5\frac{1}{2}$ yards, or $16\frac{1}{2}$ feet	= 1 rod (rd.)
320 rods	= 1 mile (mi.)
5280 feet	= 1 mile
1760 yards	= 1 mile

Volume or Capacity

1728 cu. in.	= 1 cubic foot (cu. ft.)
27 cu. ft.	= 1 cubic yard (cu. yd.)
128 cu. ft.	= 1 cord (cd.) of 4 ft. wood.

Liquid Measure

2 pints (pt.)	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)
231 cu. in.	= 1 gallon

Dry Measure

2 pints (pt.)	= 1 quart (qt.)
8 quarts	= 1 peck (pk.)
4 pecks	= 1 bushel (bu.)

Time Measure

60 seconds (sec.)	= 1 minute (min.)
60 minutes (min.)	= 1 hour (hr.)
24 hours (hr.)	= 1 day (da.)
7 days (da.)	= 1 week (wk.)
365 days	= 1 common year
366 days	= 1 leap year
360 days	= 1 interest year
100 years	= 1 century

Area

144 sq. in.	= 1 square foot (sq. ft.)
9 sq. ft.	= 1 square yard (sq. yd.)
$272\frac{1}{4}$ sq. ft.	= 1 square rod (sq. rd.)
160 sq. rd.	= 1 acre (A.)
640 A.	= 1 square mile (sq. mi.)
1 sq. mi.	= a section of land

Weight

16 ounces (oz.)	= 1 pound (lb.)
2000 pounds (lb.)	= 1 ton (T.)
2240 pounds (lb.)	= 1 long ton

Standard Weights of a Bushel

*Wheat, *potatoes, *clover seed	= 60 lb.
*Corn in ear	= 70 lb.
*Shelled corn, rye	= 56 lb.
*Barley, apples	= 48 lb.
*Oats	= 32 lb.
Coal	= 80 lb.

*In most states.

Time Measure

Apr., June, Sept., and Nov. have 30 da. Feb. has 28 da. in common years and 29 da. in leap years. All other months (7) have 31 da.

Century years divisible by 400 and other years divisible by 4 are leap years.

Measures of Angles or Arcs

60 seconds (") = 1 minute (')
60 minutes (') = 1 degree (°)
90 degrees (°) = 1 quadrant
360 degrees (°) = 1 circumference

Standard Weights

These weights are the legal bushel in many states.

Wheat	60 lb.
Corn in ear	70 lb.
Corn shelled	56 lb.
Oats	32 lb.
Potatoes	60 lb.
Clover seed	60 lb.
Rye	56 lb.
Apples	48 lb.

Approximate Values Accurate Enough in Practical Problems

3 teaspoonfuls (tsp.) = 1 tablespoonful (tbsp.)
4 tablespoonfuls (tbsp.) = $\frac{1}{4}$ cup or $\frac{1}{2}$ gill
2 gills = 1 cup   2 cups = 1 pt.   4 cups flour = 1 lb.

1 cu. ft. = .8 bushel (bu.)
1 cu. ft. = .63 heaped bu.
1 cu. ft. = .43 bu. of ear corn

$7\frac{1}{2}$ gal. = 1 cu. ft.
1 gal. water = $8\frac{1}{3}$ lb.
1 cu. ft. water weighs $62\frac{1}{2}$ lb.

$34\frac{1}{2}$ cu. ft. = 1 ton hard coal
38 cu. ft. = 1 ton soft coal

MULTIPLICATION AND DIVISION TABLE

	2's	3's	4's	5's	6's	7's	8's	9's	10's	11's	12's	
1	2	3	4	5	6	7	8	9	10	11	12	**1's**
2	4	6	8	10	12	14	16	18	20	22	24	**2's**
3	6	9	12	15	18	21	24	27	30	33	36	**3's**
4	8	12	16	20	24	28	32	36	40	44	48	**4's**
5	10	15	20	25	30	35	40	45	50	55	60	**5's**
6	12	18	24	30	36	42	48	54	60	66	72	**6's**
7	14	21	28	35	42	49	56	63	70	77	84	**7's**
8	16	24	32	40	48	56	64	72	80	88	96	**8's**
9	18	27	36	45	54	63	72	81	90	99	108	**9's**
10	20	30	40	50	60	70	80	90	100	110	120	**10's**
11	22	33	44	55	66	77	88	99	110	121	132	**11's**
12	24	36	48	60	72	84	96	108	120	132	144	**12's**
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	

NOTE.—Factors stand on the outside of the heavy line. Products and dividends stand on the inside.

ANSWERS

Answers to all examples and to certain problems are omitted from this book.

Page 1.—1. 800 sq. ft., 120 sq. ft., 920 sq. ft. **2.** \$3.90.

Page 2.—3. \$4. **4.** 160 sq. ft. **5.** 171 da. **6.** 77 da. **7.** 51 da. **8.** \$1.95. **9.** \$4.35.

Page 3.—10. 10¢. **11.** \$4.74, almost 8¢. **12.** \$1.50. **14.** 92 da., 60¢. **15.** 85¢. **16.** \$9.09.

Page 4.—17. \$7.47. **18.** 17¢. **19.** \$3.90.

Page 5.—20. \$2.20. **21.** \$3.39. **22.** \$2.35. **23.** \$3.80. **24.** \$41.30. **25.** \$45.30 **27.** \$2.95.

Page 6.—May balance, \$1.55.

Page 7.—1. \$2.60. **4.** \$2.29.

Page 13.—1. \$6.84. **2.** 36¢. **3.** \$4.37. **4.** No. **5.** \$26.12. **6.** 8¢.

Page 16.—1. 72. **2.** 22 in. **3.** 27¢ more, 27¢ less. **4.** \$4.00, \$4.80. **5.** 33, 75. **6.** 90, 10, 61.

Page 17.—8. 9. **9.** 10. **10.** 86¢. **1.** \$65 gain. **2.** 74. **3.** 178. **4.** 98,340 sq. mi., 24,090 sq. mi. **5.** 248,015, 22,565, 610.

Page 24.—1. \$26. **2.** \$51.30, 3420 mi. **3.** 65,400 ft. **4.** \$2540.25. **5.** \$105.75 gain. **6.** \$2386.40. **7.** \$88,074.

Page 25.—1. \$196.20, \$1607.21, \$5214, \$3545.10, \$998.25, \$8136, \$3543.75, \$6386.70, \$1393.92, \$389.50, \$365.04, \$756.08, \$32,531.75.

Page 27.—5. 550 bu. **6.** 4¢. **7.** 8¢.

Page 32.—1. 9 doz. 23¢. **2.** 41 bu. 4 lb. over. **3.** 86 bu. **4.** \$65. **5.** 21 bu., 3 bu. over. **6.** 5 boxes, 20 over. **7.** 7 boxes, 40 over. **8.** 744 qt., $23\frac{1}{4}$ bu. **9.** 32 bu., 27 bu., 35 bu., 30 bu. 40 lb., 33 bu. 20 lb., 158 bu. **10.** \$1.40.

Page 38.—2. 12 lb. **3.** 4 lb. **4.** 2 crates, \$4.80. **5.** 28 lb. **6.** 29 bu., \$72.50.

Page 42.—1. \$2160. **2.** 26. **3.** \$129. **4.** 547 lb., \$1535.04. **5.** 92. **6.** \$54.40. **7.** 88 mi., 232 mi.

Page 64.—2. 2. **4.** $3\frac{9}{16}$¢ **5.** $54\frac{1}{2}$ ft. **6.** $2\frac{3}{8}$ yd. **7.** $75\frac{1}{4}$ lb. **8.** \$4.48. **9.** $3\frac{1}{5}$¢.

Page 69.—4. $3\frac{7}{8}$ ft. **5.** $33\frac{3}{4}$ mi. **6.** $\frac{3}{4}$ ft.

Page 70.—7. Billy, $\frac{3}{4}$ sec. **8.** 16 ft. **9.** $8\frac{1}{2}$ ft. **10.** $15\frac{3}{4}$ ft. **11.** $18\frac{1}{4}$ yd. **12.** $214\frac{5}{8}$ lb., $6\frac{3}{8}$ lb., $1\frac{5}{8}$ lb. **13.** $122\frac{3}{8}$ bu., $4\frac{3}{4}$ bu. **14.** $385\frac{1}{2}$ A., $104\frac{15}{16}$ A.

Page 71.—15. $66\frac{5}{8}$ A., $3\frac{1}{2}$ A. **16.** $302\frac{3}{4}$ lb., \$179.34. **17.** $1\frac{1}{12}$ min. **18.** \$3.54. **19.** $297\frac{1}{8}$ lb. **20.** $24\frac{1}{2}$ ft.

Page 77.—1. \$85.50. **2.** \$26.13. **3.** 98¢. **4.** 21 in. **5.** \$2.97. **6.** 264 ft. **7.** 25¢, 50¢, 25¢. **8.** \$122.50. **9.** \$7950. **10.** \$21.78. **11.** \$1.44. **12.** \$2.60. **13.** \$6.25.

Page 80.—1. 5 A. **2.** $\frac{5}{18}$. **5.** $\frac{1}{2}$. **6.** $\frac{7}{8}$. **7.** $\frac{1}{2}$.

Page 82.—1. 196 mi. **2.** $30\frac{1}{4}$ A. **3.** 50 lb. **4.** \$1.52.

Page 83.—**6.** $30\frac{1}{4}$ sq. yd. **7.** $272\frac{1}{4}$ sq. ft. **8.** 24¢ **9.** 2666 sq. in. **10.** $24.38.

Page 89.—**1.** 8. **2.** 8. **3.** 6. **4.** 8. **5.** 5. **6.** 81. **7.** 36. **8.** No. **9.** 45 min. **11.** 16. **12.** 20. **13.** 6. **14.** 4.

Page 90.—**1.** 90¢. **2.** 3. **3.** 3 hr.

Page 93.—**3.** $\$\frac{4}{25}$, 25 doz. **4.** $\frac{1}{8}$ A. **6.** 45 ft.

Page 95.—**1.** $2\frac{2}{3}$ yd. **2.** $\frac{1}{2}$ bu. **3.** $\frac{3}{4}$ lb. **4.** $7\frac{1}{2}$ A. **5.** $\frac{1}{8}$ bu. **6.** $\frac{3}{4}$ cord, 96 cu. ft. **7.** $6.

Page 130.—**4.** 50¢. **5.** $1.19.

Page 131.—**6.** $3.15, 11¢. **7.** 59¢. **10.** 39¢.

Page 132.—**1.** 15¢. **2.** 34¢.

Page 133.—**3.** $2.10. **4.** 17¢. **6.** (3) $6.89, 42¢, 20¢.

Page 138.—**14.** (1) 45 ft., 25 ft. (2) 16 plants, 9 rows. (3) nearly 22¢.

Page 147.—**6.** $15. **7.** 48 ft. **8.** $3\frac{3}{4}$. **10.** 96 cu. ft., 64 cu. ft.

Page 149.—**10.** 841+gal. **18.** 498+gal. **20.** $30.

Page 155.—**1.** $1.87. **2.** 10. **6.** 160. **7.** $18.80, $58\frac{3}{4}$¢.

Page 156.—**8.** 109+min., 1 hr., 49+min. **9.** $2862.10. **10.** $26. **11.** $167\frac{1}{4}$ rd. **12.** $1\frac{1}{2}$ tons. **13.** $\$\frac{3}{8}$, $9. **14.** $7\frac{1}{2}$ mi. **15.** $\frac{1}{8}$ lb. **16.** $26\frac{7}{8}$ bu.

Page 170.—**6.** 1123.2 mi.

Page 171.—**7.** 12.372 tons. **8.** 786.29 ft. **9.** 15.16 in., 5.2 in. **10.** 79.7 mi.

Page 173.—**4.** 163.4 mi. **5.** 190.9 mi. **6.** $.0066, $.057. **7.** 20.7 mi. **8.** 22.7 acres.

Page 177.—**13.** $4656. **14.** $1.13. **15.** 605,952 cu. in., 2623+gal.

Page 181.—**14.** 107.8125 lb. **15.** 3205.3125 lb. **16.** 4657.5 lb. **17.** 17.325 lb. **20.** 1,455,252.48 cu. in.

Page 184.—**1.** $6.111+. **2.** $20.30. **3.** 34.72+mi. **4.** 0.238 in. **5.** 1.783+ in. **6.** 41.33+cu. yd. **7.** $36.54. **8.** 1.446+¢. **9.** .09¢. **10.** 0.604+¢. **11.** 10.8 tons.

Page 189.—**1.** 16 lb. **2.** $62\frac{1}{2}$ lb. **3.** $.085+. **4.** $.005. **5.** 22.85+mi. **6.** 22.6+hr. **7.** 33.02+mi. **8.** 34.6+mi. **9.** 0.714+mi., 71.4+mi., 1.81+mi., 3.62 +mi. **10.** 27.6+cu. in.

Page 194.—**6.** $71,428,571\frac{3}{7}$ lb. **7.** $230,340\frac{6}{7}$ cans. **8.** 2.83 in. **9.** 2.6 in. **10.** Deficiency. 23 in. **11.** 37.69+gal.

Page 195.—**12.** 66.24 tons. **13.** $163.24. **14.** 307.3+bu. **15.** 10 ft. 4+in. **16.** $130\frac{3}{8}$ gal., $912\frac{5}{8}$ gal., $47,586\frac{7}{8}$ gal. **17.** $.00737. **18.** 35¢. **19.** $8181\frac{3}{4}$ sq. ft., .18+acre. **20.** 5+tons.

Page 196.—**1.** $233,440,900, $291.80. **2.** (a) $6,000,000,000; (b) $54.54; (c) $66,000,000, $930,000,000, $1,674,000,000; (d) $993,073,250. **3.** $2,375,540,950. **4.** 1.16+.

Page 197.—**1.** (1) 524,160; (2) 5460 oz., $341\frac{1}{4}$ lb.; (3) $9.14. **2.** About $1. **3.** $7,951. **4.** $.005.

Page 201.—**11.** $1020. **12.** $19.80. **13.** 9.

Page 202.—**14.** $337,381,200. **15.** $6,866,400,000. **16.** $630,000,000. **17.** $215,040,000. **18.** 33,600,000 tons, 12,320,000 tons, 10,080,000 tons. **19.** 8,190,000 bu. **20.** 3,717,816 bales, 2,120,816 bales.

Page 205.—**3.** 23−%. **4.** $58\frac{1}{3}$%. **5.** 10.8—%. **6.** 9.7+%. **7.** $18\frac{3}{4}$%.

Page 207.—**4.** .598, .608. **5.** Cleveland, .572; N. Y., .490. **6.** Washington, .554, Detroit, .436. **10.** Subtract 5 points, add 5. **1.** 31.9+%.

Page 208.—**2.** 95.8+%. **3.** About 1%. **4.** .46% too low. **5.** 1.37+% too high. **6.** $118.80, 11.88%. **7.** 35.38%, $83,950,000. **8.** 91+%.

Page 211.—**3.** $282. **4.** $264. **5.** Cost, $160; gain, $20; gain, $22.50. **6.** $90.60. **7.** $45.36. **8.** $35.

Page 212.—**1.** 168. **2.** 38.

Page 224.—**4.** 60¢. **5.** $38. **6.** 16%. **8.** $225, 31.8%. **13.** 2613.6 ft., $222.

Page 225.—**5.** 1.5+% too high. **6.** $33\frac{1}{3}$%. **7.** 12.6+tons. **8.** $151.96. **9.** $287\frac{1}{2}$ lb. **10.** .92.

Page 226.—**1.** 51.1+mi. **2.** 48.86+mi. **3.** 26.4 sec. **4.** $37\frac{1}{2}$ mi. **5.** 450 mi. **6.** 74.8—mi. **7.** 119.8+mi. **8.** 1 mi. in 30+sec. **9.** 6.1+mi. an hr. slower. **10.** 7040 ft., $117\frac{1}{3}$ ft. **11.** The latter, $1\frac{1}{3}$ ft. per sec.

Page 229.—**3.** 74¢. **4.** $1.49. **5.** $2.01.

Page 230.—**6.** $4.24. **7.** 15¢, 2.8%. **8.** 20¢. **9.** 43−%. **10.** 40¢ and use 4 oz. more beans. **11.** 12% over qt. price, $14\frac{2}{7}$% if bought by qt. instead of by pt.

Page 232.—II. **1.** 14.2−¢. **2.** $2\frac{3}{8}$ lb.

Page 233.—**1.** (1) $104.26; (2) $69.04, $6.904; (3) $161\frac{1}{4}$, 16+; (4) $8.69—, 2.93\frac{1}{3}$, 196+%. **2.** (1) $17.63; (2) $14.33; (3) 84−¢; (4) $.0117.; (5) $.16.

Page 234.— I. **2.** $416\frac{2}{3}$ lb. **3.** 277+days.

Page 234.—II. **1.** 260 lb. corn, 20 lb. rye. **2.** $7.50. **3.** 200 days. **4.** $.003$\frac{1}{8}$.

Page 235.—**1.** $27.45. **2.** $8.75. **5.** 91, rem. 5¢.

Page 236.—**1.** 80¢. **2.** $11\frac{3}{7}$%. **4.** 16.7−tons, 15.16−tons. **6.** 48¢. **7.** $6.75.

Page 237.—**1.** 12,700 cu. ft. **3.** $2.43. **4.** $.24. **5.** $2.88.

Page 238.—**4.** $1.52. **5.** 25%.

Page 239.—**2.** $1.50, $.90. **3.** $1.60, $1.20, $.80; 40¢, 30¢, 20¢. **4.** 90¢, $37\frac{1}{2}$%.

Page 243.—**7.** 88¢. **8.** $33.52, $.48. **9.** $45.41, $71.27.

Page 245.—**2.** 5; Apr. 1, June 1, Aug. 1, Nov. 1, Jan. 1. **3.** $1.00. **4.** One.

Page 246.—**5.** $126.52, $229.04. **6.** 3, 4¢ over. **7.** $333.62. **8.** $6. **10.** $6.38. **11.** $1.00.

Page 253.—**1.** $11\frac{1}{9}$%, $12\frac{1}{2}$%. **2.** 10%, $11\frac{1}{9}$%. **3.** 60%. **4.** 20%. **5.** $42\frac{6}{7}$%. **6.** 12.9−%. **7.** 14.9−%. **8.** 17.1+%. **9.** $16\frac{2}{3}$%, 32.7−%, 38.1+%, 43.2+%.

Page 254.—**2.** 261, $\frac{1}{4}$ lb. over. **4.** 84%. **5.** 23¢. **6.** $1.28 a yd. **7.** 20%, $16\frac{2}{3}$%.

Page 255.—**1.** $229. **3.** $109. **4.** $61.43. **5.** $36.12. **6.** $51.14. **7.** $800. **8.** $4, $36, $40, $60, $60.

Page 256.—**1.** $16.12. **3.** $1.30. **5.** $85.50. **6.** 36 sticks, 24 sticks. **7.** $4.25, $42.50. **8.** $13.26.

Page 260.—**2.** 46 ft. 6 in. **3.** 145 ft. 6 in. **4.** 354 ft. 9 in. **6.** 59 rd. 1 ft. **7.** 20 yd. 2 ft.

Page 261.—**4.** 96 yd. 2 ft. **8.** 5 in. **9.** 83.3−ft., 4.7+ft.

Page 262.—**2.** 118 ft. 10 in. **3.** 2 yd. 2 ft. **4.** 122 ft. **5.** 62 yd. 2 ft. **6.** 58 ft. 10 in. **7.** 46 ft. 4 in., $4.63. **8.** 1874.8 rd., 57.12+mi.

Page 263.—2. 5. 3. 7 ft. 10 in. 4. 13, 10 in. over. 5. 40 rd. 10 ft. 6. 31. 7. 12. 9. 300. 10. 52.5 mi. 11. $2.40. 12. 10, 40 in.

Page 269.—9. (1) 3 in., $\frac{7}{16}$ sq. in; (2) 21 in., $15\frac{5}{16}$ sq. in.; (3) $44\frac{11}{16}$ sq. in., 25.5+%; (4) $\frac{5}{9}$, $55\frac{5}{9}$%.

Page 270.—10. 6 mi. 11. 4 mi. 14. 432 sq. in.

Page 277.—1. 28.5+gal. 2. 140.8 bu. 3. 60.48 bu. 4. 619.2 bu. 5. 34+ qt. 6. 70, 55.1+, 37.6—. 7. 44.05+, 48.52.

Page 279.—16. 176.4+lb., 185.2−lb., 167.1−lb. 17. Average is increased 8.8+lb., or 5.4+%.

Page 284.—1. 141.75 cu. ft. 2. 2133.6+gal. 3. 23221.26 cu. ft. 4. 3. 5. 4666.875 sq. ft. 6. 3.125 ft. 7. 80 mi., $1\frac{1}{3}$ mi. 8. 11.25 sq. ft. 9. 72. 10. 63, 318 sq. ft. rem.

Page 285.—12. 1.133+in. 13. 57.1 lb., 5.4 lb. 19. 222.2 loads.

Page 295.—12. $37.50. 13. $27,500. 14. $4\frac{3}{4}$ ft.

Page 298.—1. 4.8 oz. 2. (1) $180; (2) $16; (3) $362.50; (4) $1375.

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